Compressed Air Magazine

SKILLED WORKMAN
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A Goblet Takes Form
With Precision
And Patience

NOVEMBER 1958 NEW YORK • LONDON

Bethlehem Hollow Drill Steel tackles sandstone at site of Dyberry Dam, a flood control project in eastern Pennsylvania. Contractor: The Hunkin-Conkey Construction Co., Cleveland. Drill steel reconditioner: Howells Mining Drill Corp., Plymouth, Pa.

They moved 270,000 cu yd for new flood control dam

Using Bethlehem Hollow Drill Steel to drill the blast holes, they recently moved some 270,000 cu yd of sandstone in the initial phase of building Dyberry Dam near Honesdale, Pa. To control the Dyberry Creek, the earth-and-rock dam, 1600 ft long and 112 ft high, is being built under the direction of the U. S. Army Corps of Engineers, Philadelphia district.

The blast holes which were put down by the contractor, The Hunkin-Conkey Construction Co., averaged 10 ft in depth. The Bethlehem Hollow was used in wagon drills, jackhammers, and drifters.

Bethlehem Hollow Drill Steel is ideal for all types of rock drilling because it is rolled from fatigue-resistant steel, and has a uniform, centrally located hole. Besides having a wide quenching range, Bethlehem Hollow is easy to heat-treat for the proper balance of toughness and wear resistance, thus making possible tough threads and shanks.

Bethlehem Hollow comes in Carbon and Ultra-Alloy grades in rounds, hexagons, and quarter octagons, in lengths from 18 ft to 27 ft. Longer lengths can also be furnished. No matter how tough the drilling, you can count on Bethlehem Hollow to give you top performance.

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CARBON *AND* ULTRA-ALLOY

BETHLEHEM STEEL

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Write for complete information on any of the Staynew filters illustrated. Be sure to specify Bulletin Number or Numbers. Consult Dollinger Engineers on any special filtration problems—no obligation. Dollinger Corporation, 7 Centre Park, Rochester 3, N.Y.

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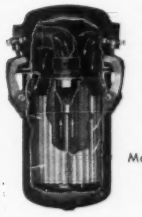
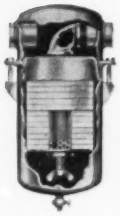
Pipe Line Filter
Bulletin 200



Model CVH (Vacuum)
Pipe Line Filter
Bulletin 200

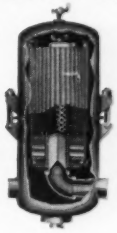


Model AAPHS
(Absorption)
Pipe Line Filter
Bulletin 200

Model HPH and AHPH
(High Pressure)
Pipe Line Filter
Bulletin 200

LIQUID FILTERS

Model HE (Sump)
Liquid Filter
Bulletin 330



Model ELS (Pressure)
Liquid Filter
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AIR INTAKE FILTERS

Model IDR
(Ground Level)
Air Intake Filter
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Model DS (Silencer)
Air Intake Filter
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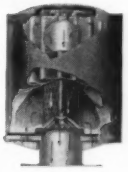
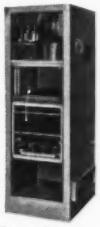


Model D (Outdoor)
Air Intake Filter
Bulletin 100

Model C (Indoor)
Air Intake Filter
Bulletin 100

VENTILATION FILTERS



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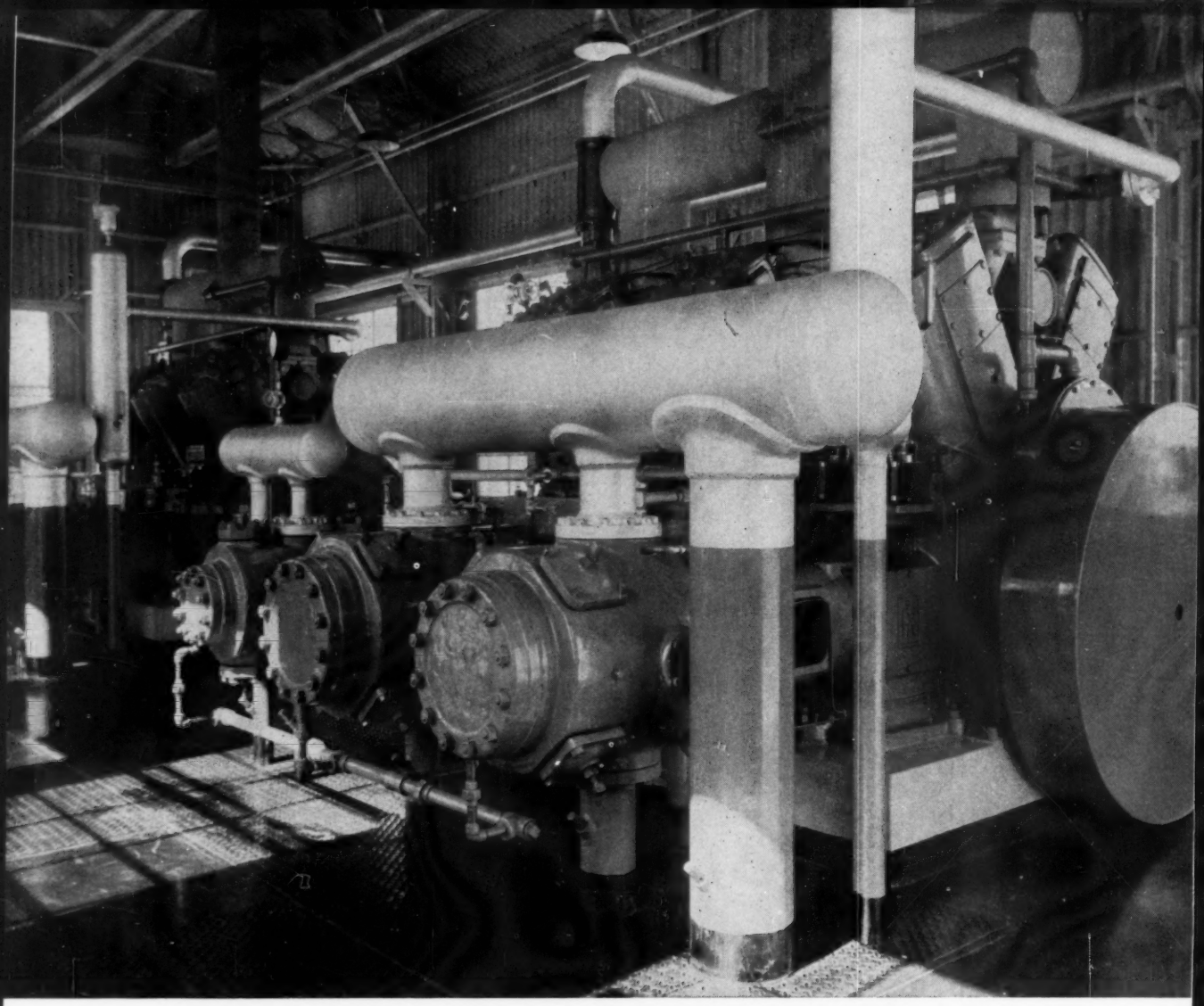

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ON THE COVER

A GAFFER, one of a team of craftsmen working at Steuben Glass, is shown shearing the excess glass from the rim of a bowl that will eventually form the uppermost portion of a crystal goblet. He maintains the shape of the soft, hot metal by constantly rotating his iron on the arm of his bench. Since glass must be worked while at high temperatures, great skill must be exercised. This month's article, *Steuben Glass*, tells of the company and illustrates, in a picture story, the handcraftsmanship required to make the goblet shown on the cover.

FEATURE ARTICLES

Page 10 Air Supply For An Aircraft Plant—*R. L. Gunter*
High and rising labor and material costs make it necessary to design compressed-air plants so that efficient use can be made of air supplies. The experience of one firm's Air Utility Committee may be a guide to compressed-air-plant planning. The author is the Committee Chairman.

14 Steuben Glass—*S. M. Parkhill*
Material, workmanship and design—the requirements for fine crystal—are described in the story of a goblet made in a modern factory where centuries-old practices of shaping glass can still be seen.

20 Subaqueous Pipeline—*Ruel McDaniel*
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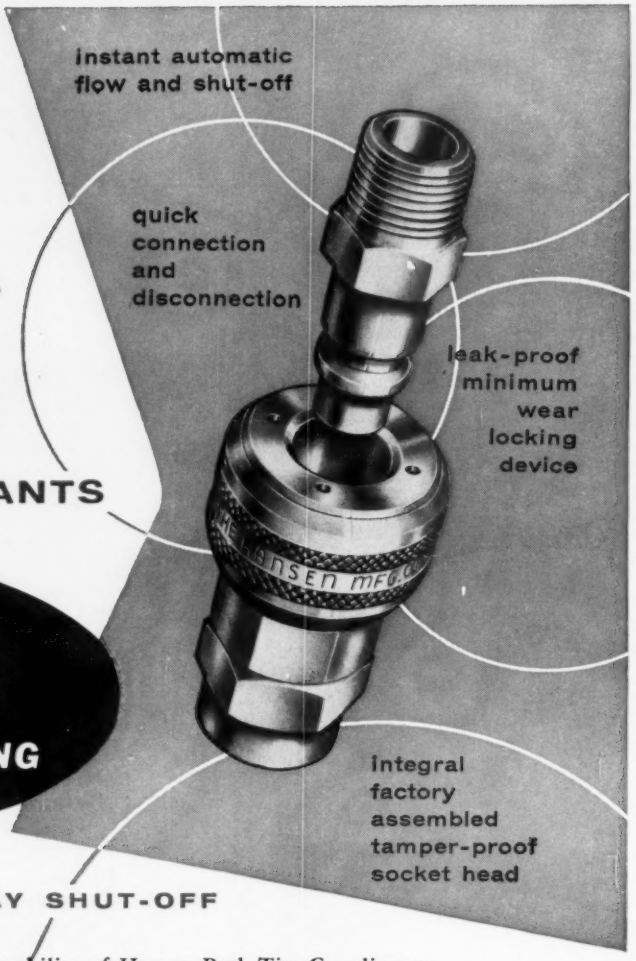
Thoroughly Proved...

BY YEARS OF HARD EVERYDAY USE IN THOUSANDS OF PLANTS


instant automatic flow and shut-off
quick connection and disconnection
leak-proof minimum wear locking device
integral factory assembled tamper-proof socket head
THE HANSEN MFG. CO.

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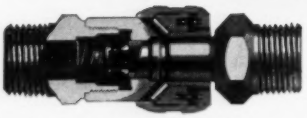
QUICK-CONNECTIVE

PUSH-TITE COUPLING



Locking pins in Hansen Push-Tite Coupling Socket afford large area contact with plug, thereby preventing wear and subsequent leakage.

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To connect the Coupling, you merely push the Plug into the Socket with one hand. Flow is instantaneous. To disconnect, push back sleeve on Socket – Coupling disconnects. Flow is shut off instantly and automatically.

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AIR • OIL • GREASE
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Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen Quick-Connective Couplings. Write for your copy.

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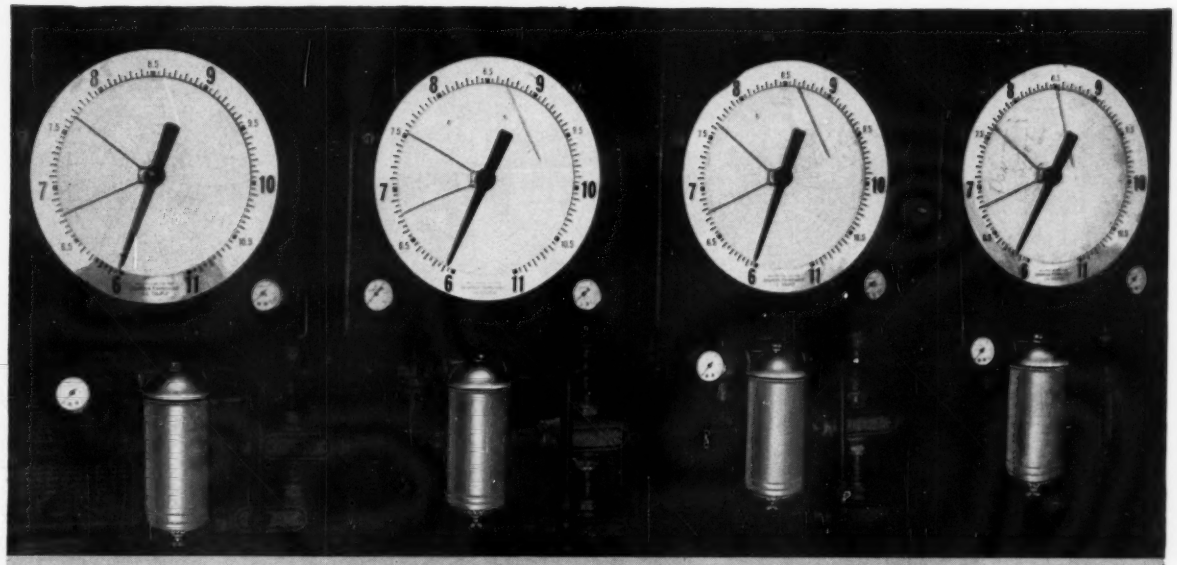

Acme Wire Company safeguards accuracy of air-operated heat controls . . . with *Fulflo Filters*

Fulflo Filters, with genuine Honeycomb Filter Tubes, protect these temperature controls at Acme Wire Company, New Haven, Connecticut, by keeping airlines free from microscopic impurities. And that's mighty important — for these instruments control the critical temperatures in the "curing" of enamel insulation. Fulflo Filters minimize gumming — remove moisture, oil, microscopic dust, rust, dirt and scale. By safeguarding accurate operation of these heat controls, Fulflo Filters help assure precise o. d. tolerances for insulation on all Acme magnet wire.

Single-tube Fulflo Filters have 3, 5 or 7-inch Honeycomb Filter Tubes for 10, 30 and 60 cfm at operating pressures up to 125 psi; also for 60 cfm at 250 psi. Hi-Pressure Filter withstands operating pressures up to 4,000 psi. Newest model is a nickel-plated brass Fulflo Filter — sanitary and non-rusting. For high flow rates or central installations, several multi-tube models are available in steel-and-iron, stainless steel or nickel-plated brass to accommodate pipe sizes of 1½, 2, 3, 4 and 6 inches.

For new catalog on Fulflo Filters for compressed air, CO_2 and other gases, write to Department CA.

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★ Miscellaneous: sealing rings wearing directly against aluminum cylinders, wear bushings, wear inserts, and plug-type pistons.

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Koppers K-30 piston, wear and sealing rings may be made in all widths and diameters—for use with cast iron, stainless steel, aluminum or chromium-plated cylinders.

Radical, rugged Koppers K-30 gives you new operating economy and long-lived performance in applications too tough for ordinary piston and sealing ring materials. K-30, a special compound of TEFLON* with other wear-resisting materials, features:

★ *Low friction coefficient* – inhibits ring wear.

★ *Self-lubrication* – reduces cylinder wear.

★ *Zero water absorption* – means that it cannot swell or change its shape.

★ *Temperature resistance* – from a molecular structure that permits operation at temperatures from – 350° F. to 500° F.

★ *Toughness and flexibility* – eliminate breakage, scoring and other damage caused by storing, handling, installing or servicing. Permit smaller ring cross-sections and smaller piston sizes and weights.

★ *Chemical inertness* – makes K-30 corrosion-proof.

If you have a ring problem, put Koppers to work on it. Contact your nearest Koppers Representative or write KOPPERS COMPANY, INC., Piston Ring and Seal Dept., 1611 Scott St., Baltimore 3, Md.

*TEFLON—trademark of E. I. DuPont de Nemours & Co. for tetrafluoroethylene resin.

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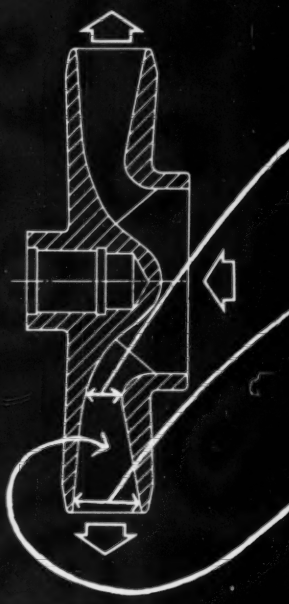
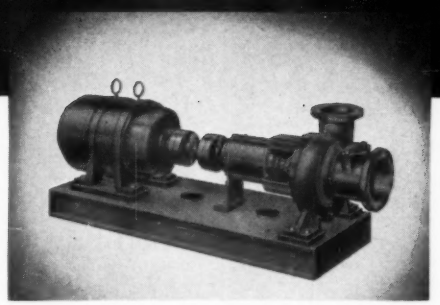


1. *Impeller width at center is smaller than at periphery...*
2. *Hence there is a greater area at the discharge than at the inlet*
3. *So the material pumped can't enter fast enough to replace the ejected liquid, and vacuum space is formed between the blades*



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This simple, patented diverging impeller design, with few blades and properly proportioned casing, gives the new I-R Stock Pump its almost unbelievable operating characteristics.

Treated, sized or foamy stock containing *entrained air or gas* can be pumped without losing prime or vapor binding. That's because the entrained air or gas enters the *vacuum space* between the blades and passes through the pump. In fact, prime cannot be lost as long as the pump is running, even when the level of stock in the chest is lowered to a point where the suction opening is partially uncovered.

I-R stock pumps are currently used to replace conveyors handling stocks with bone-dry consistencies as high as 11%. Pulp of a consistency of 8% can be moved without a feeder. This means greater storage capacity and economy in mill water requirements. These pumps can also be furnished with a conventional type impeller for handling lower consistency stocks.

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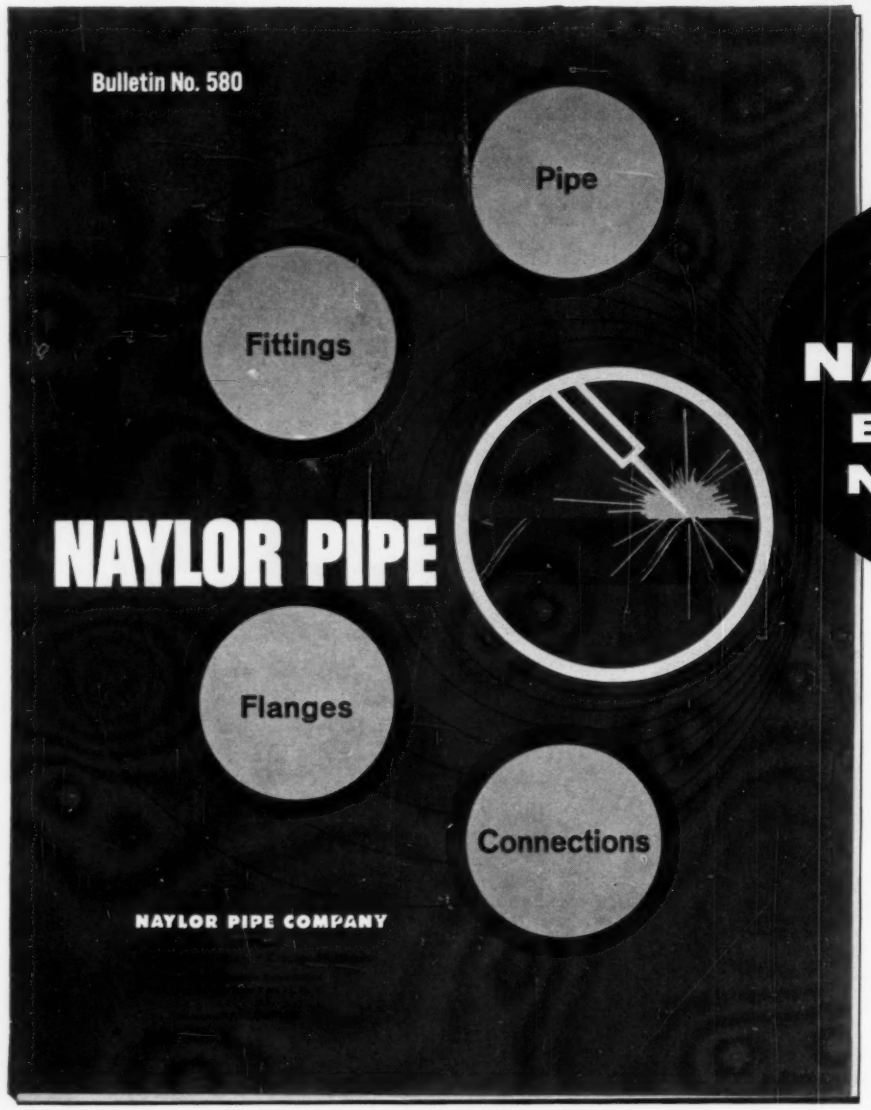

Write for NAYLOR Bulletin No. 580

Here in concise form is helpful data covering NAYLOR pipe, fittings and connections for use in the construction field. Bulletin No. 580 includes standard specifications on NAYLOR Spiralweld pipe in sizes from 4″ to 30″; standard fittings and welding flanges carried in stock; NAYLOR Wedgelock couplings and all types of connections to meet pipe line needs. Write for your copy today.

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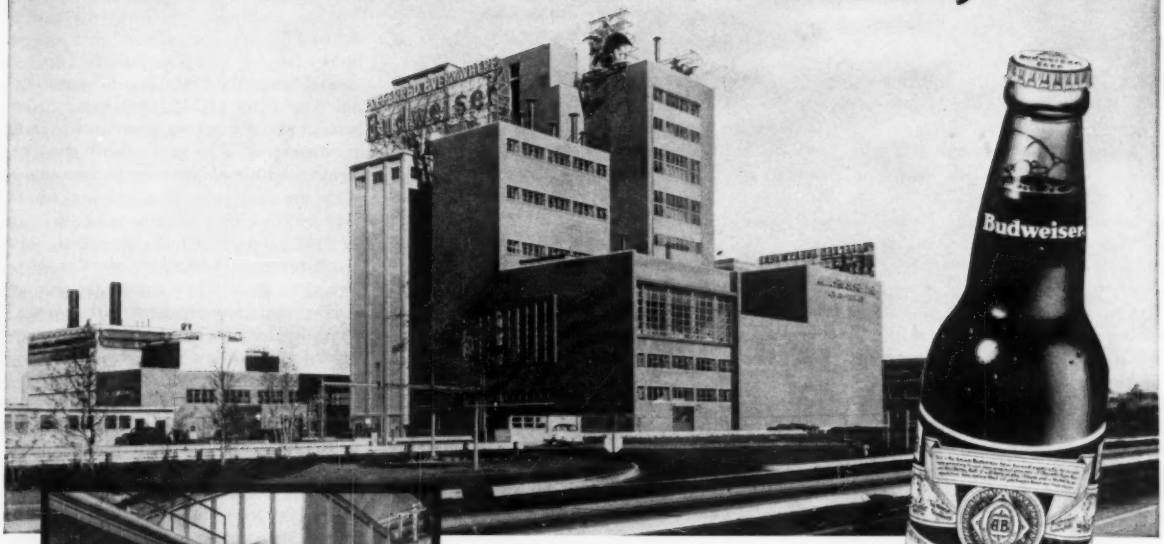
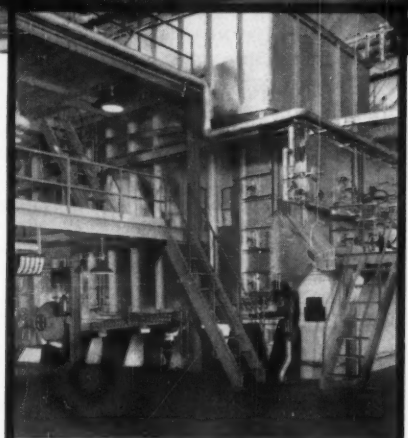
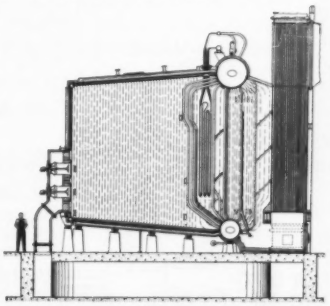




The Newark, N. J., brewery of Anheuser-Busch, Inc. The seven year old power plant, left, is so spectacularly clean and neat that it has constituted a major attraction for professional and technical groups along the eastern seaboard. The popularity of these tours is such that, currently, reservations must be made two months in advance.

(Above) One of the two C-E Type VU-50-B, oil-fired boilers in the Newark brewery (cross-section below). Each has a maximum continuous capacity of 100,000 lb per hr and produces steam at 550 psi and 750 F. The floor in the foreground is chemically cleaned daily, polished twice weekly and completely refinished yearly.



In a brewery, the demands placed upon its boilers can be rigorous indeed. At the Anheuser-Busch brewery in Newark, New Jersey, they provide steam for power generation, for processing and for numerous high-capacity instantaneous water heaters used in various brewing and bottling operations. Since brewing is essentially a "batch" process, steam demands fluctuate sharply and continuously. Yet the C-E Boilers installed at Newark have consistently exceeded performance guarantees and operate at an efficiency of 86%.

Mr. Herman Paradies, Superintendent of Utilities at the Newark brewery, has stated that it is not unusual for steam demands to rise from 80,000 to 130,000 pounds per hour in ten to fifteen seconds, and that the boilers have responded with nominal loss in pressure or temperature. This enviable record, which speaks well both for boiler design and for the skills of the power plant's operating management and staff, is one of which Combustion is proud.

When *you* need boilers, remember that C-E has a complete line of time-tested and service-proved designs and that there is a size and type which will fit your needs and serve you equally well.

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AIR SUPPLY FOR AN AIRCRAFT PLANT

North American Aviation's Design Criteria For An Efficient Air-Supply System

R. L. Gunter, M. E.*

THE MODERN aircraft factory looks upon its compressed-air system as a utility. To maintain production standards by meeting the fluctuating volume demands common to aircraft manufacture, the supply must be flexible over a wide range. Furthermore, provisions must be considered for reducing or increasing system capacity to meet changing fabrication methods, as well as the ups and downs of production schedules. The volume of air required for inspection, development and research, ven though unpredictable, must be supplied, but not at the cost of reducing plant pressures below production demands.

To arrive at a practical solution to air-supply problems, an Air Utility Committee was formed at North American Aviation's main plant at Los Angeles, Calif. Composed both of maintenance and engineering personnel from the mechanical field, the Committee is a fact-finding service unit established to strive for better conditions and greater economies. After considerable trial and research on air plants and their detailed parts, certain selections and arrangements were found to be preferred. This experience in coping with specific problems resulted in the accumulation of a great deal of data on design and installation of compressed-air plants. Although probably not universally applicable to air-supply problems in other factories, the conclusions represent an engineering approach to the problem with which most makers of air compressors and air-system components will agree. No two of the presently installed air plants are exactly alike due to the conditions under which each was established. Therefore, a true standard cannot be formulated; however, the plants are similar in basic principles.

*Chairman, Air Utility Committee, North American Aviation.

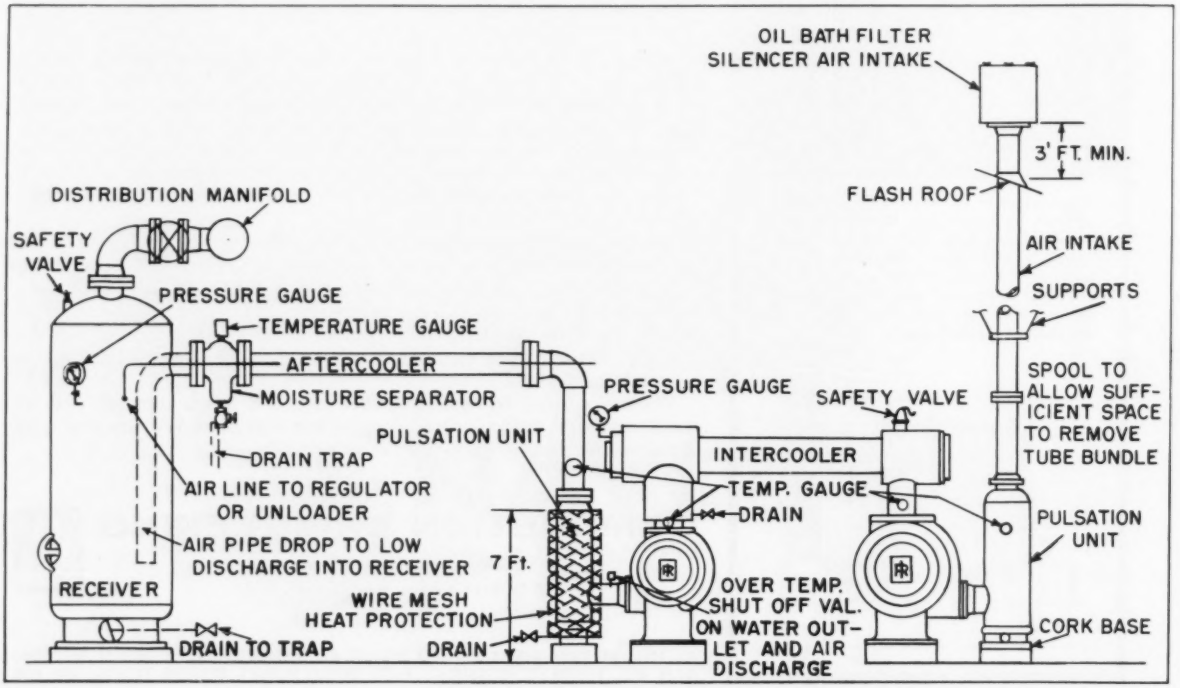
General Considerations

Designing a compressed-air plant, according to the Air Utility Committee, is an art similar to tool design; it must not be too greatly restricted or operational economies may be impaired. All elements of the entire plant must be studied when the cost of air is computed. Like any other utility, unit costs, amortization and return on investments must be considered. It was found that the compressed-air plant must be engineered as an integral part of a production facility. Provisions must be made to supply the load assigned to the system, with future forecasted loads or revisions considered as well. New methods; changes in air-powered equipment; other anticipated future needs; and the rate and type of production: all govern the size and design of the air plant along with its distribution system.

To allow for surge demands on the air plant and to provide for mainten-

PLANT LAYOUT

The diagrammatic sketch, illustrated below, is of a compressor plant and points up the major features of the Committee's recommendations for installations of compressors. Specifications call for clean, well-lighted, cool and dry areas that are large enough for all repair and maintenance activities. The firm also specifies a color-coded paint job on all components.



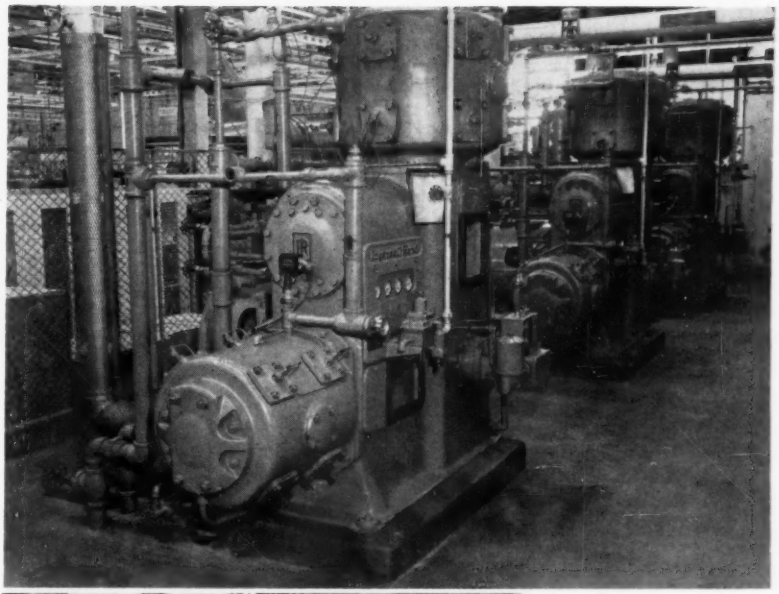
ance down time, a multicompressor plant with automatic step unloaders, controlled in sequence, has proved quite flexible for North American Aviation. This type of plant, it has been determined, should be designed to provide excess capacity for quick recovery from pressure-reducing loads. Stand-by connections and portable air compressors provide auxiliary air when plant units are out of service. Multistage compressors operate cooler. Thus, they are better suited for delivering air at required production pressures in a remote area.

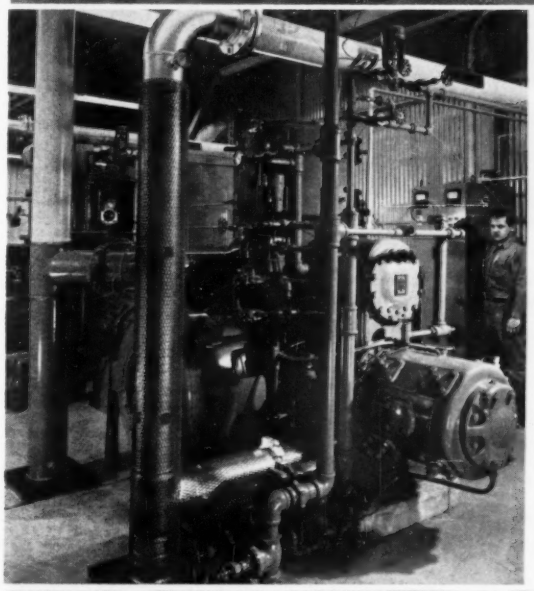
A quantity of air per factory operator, or a unit of air per square foot of shop area, has proved to be an intangible modulus for the firm's air plants. The proper capacity required instead must be determined from a study of the air-operated devices in the actual plant or a similarly established one. It has been noted that relatively few devices use air continuously, although some use large quantities; air hammers, for example, literally gulp air. "Load factors," or the percentage of time that a known volume of air is used, must be established for each piece of equipment in operation to aid in computing the total system volume required to maintain proper production pressures.

Both peak and minimum load demands must be established for each facility. When the air volume is large, the load should be carried by several duplicate compressors. This method will permit partial down time without curtailing production.

For off-hour economy, a small self-contained air compressor has proved its value for supplying air for shop whistles, air conditioning controls, paint agitators and the like, that generally require a supply of air at all times. Auxiliary units can be set to cut in below normal plant operating pressures and will then remain idle during production hours.

For trouble-free operation, the air manifold and distribution piping should be oversized. This will add to the storage volume, deliver air with less pressure drop, assure faster recovery of pressure at distant points and provide flexibility for future increases in demand. Long distribution lines are best served by placing air-flow-type storage or pulsation units near the far end or at points of heavy demands. Such units may also serve as a plenum, feeding several air hammers or similar equipment. Where possible, a loop system should be con-





MAIN AIR SUPPLY

Shown, in the views above and at the left, is one of North American Aviation's main plant air-supply facilities. Most of the points discussed in text material are visible in these pictures, including temperature controllers on the cooling water supply, sight-flow glasses on cooling water lines and the expanded metal protection on discharge piping. The compressor area is separated from the rest of the plant by chain-link fencing sections that can be removed to facilitate maintenance work. Intake and discharge piping, it can be seen, is all welded with the exception of a single Victaulic coupling close to the machine and the flanged connection to the pipeline-type aftercooler overhead.

FOUNDATION WORK

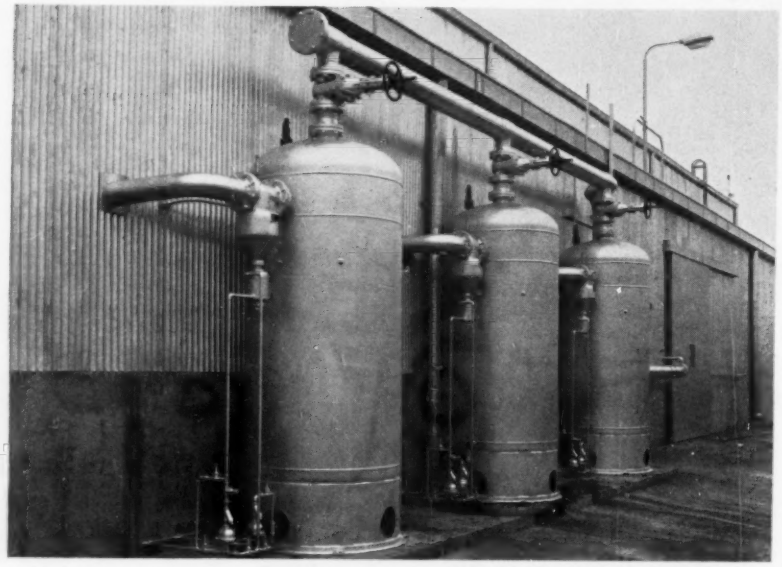
The multicompressor installation shown in the two illustrations above is founded on a single slab footing, a method the Air Utility Committee found would increase stability and lessen vibration. The picture at the right shows the foundation for those machines being poured. In all cases, the bed is carried to solid ground.

sidered to provide a 2-way flow for balancing fluctuating demands.

To conserve power and maintain pressure, the air leaks in a system must be held to a minimum. Screw pipe connections, due to temperature changes, vibration and pressure surges, are susceptible to leaks and must be periodically serviced. Conditions permitting, economies will be found in welded pipe.

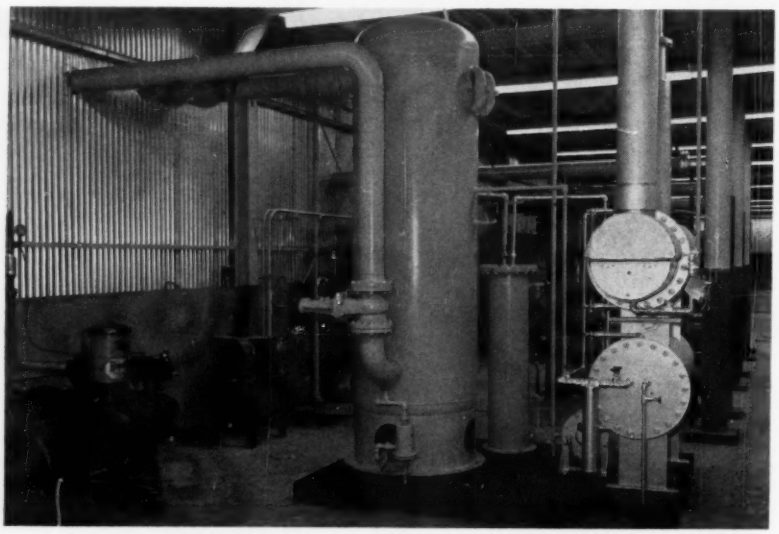
Compressor rooms, as well as each compressor, should be properly ventilated to retain efficiency and to prevent overheating. Positive-pressure circulation systems with the air flow directed over the equipment will give the best results. Exhaust systems generally "short-flow" through a room, it has been found, leaving unaffected areas. When walls, windows, louvres, etc., will permit it, a gravity-type system may prove economical. No matter which system is used, the heat from starters, motors and other electrical apparatus must be removed.

Good water cooling calls for a system large enough to remove the heat put into the plant (calculated on a horsepower basis), as well as a ventilation system that will remove the heat radiated from the equipment.



RECEIVER INSTALLATION

The Committee recommends that receivers have top discharges with high inlets and an internal drop pipe discharging near the base. This installation is out-of-doors to promote better cooling through radiation and also to save interior floor space. Automatic-discharge condensate traps are visible at the bottom of each receiver as well as the discharge for the moisture separators installed at the inlet to the receiver.



DRIER AND AUXILIARY COMPRESSOR

An aircraft manufacturer has many requirements for dry air. The rules for installation of this equipment follow the general pattern laid down for all system components, including keeping the equipment off the floor. In the left corner is shown an Ingersoll-Rand Type 40 auxiliary compressor that supplies air during off-hours to operate plant whistles, and other round-the-clock air users.

Plant Layout

The aftercoolers, especially pipeline types, are generally the yardstick used in plotting a compact air plant; room must be left for the removal and replacement of tube bundles as well as other machine components. Compressor repair and dismantling space are shown on the manufacturer's certified prints. In addition, intake filter servicing, receiver inspection, workbench space, repair equipment and service parts storage must also be considered.

Installation

The certified prints furnished by the compressor manufacturer will show an appropriate mass foundation for a good average condition. The Committee has found that when several compressors are to be installed, a single slab-footing will reduce vibration and give better support with less foundation weight. Overhead piping is preferred to an underground or trench installation because it is easier to inspect, clean and maintain. Cooling water loops and drains, on the other hand, are better placed below ground. Floors that are free of pipes and related equipment promote better housekeeping and are safer. When air lines are designed for the reduction of vibration and pitched to eliminate dirt, oil and condensate, considerable maintenance time can be saved.

Specific Pointers

After checking conditions and analyzing the performance of a number of compressor plants, the Committee has found that the installation methods affect the operational costs as well as the selection of equipment. The following dozen items are based on these findings:

¶Foundations should be carried to solid ground, and machines in a multicompressor installation should be placed on a common slab. The result will be increased stability and reduced vibration.

¶Piping should be self-supporting. This will prevent undue strains on the compressor and also reduce maintenance work and time.

¶Pulsation dampeners should be installed both on the inlet and outlet of the compressor. This will reduce transmitted vibrations, increase air delivery by cutting down on friction losses and, in the case of the outlet unit, provide a drip leg for dirt and condensate, pre-

venting liquids from back-flowing into the machine's discharge valve chamber.

¶Aftercoolers should be placed close to, and above, the compressor. This will reduce the pipe runs necessary to carry the air to the cooler thus keeping passages cleaner and providing better heat radiation. Each aftercooler, of course, requires a moisture separator to remove condensate caused by lowering the temperature of the saturated air.

¶Receivers should be piped with a top outlet and a high intake connection with an internal drop. The top outlet aids in locating or relocating an air receiver, permits manifold connections out of the way and adds to the stability of the tank. The high inlet, internal drop shortens the pipe runs from the compressor to the receiver and provides greater floor space than connections near the base. In addition, it lends itself to fewer changes in the direction of air flow, lower velocities and adds to receiver stability.

¶Filters on inlet lines should be of the oil-bath silencer type, placed out-of-doors in the cleanest possible location. Air taken outside is cooler, thereby lending to the compressor's volumetric efficiency. The silencer aids in pulsation dampening and reduces the noise level of the installation. Dirt and dust from interior operations do not accumulate on the filter as quickly.

¶Temperature controls on cooling loops of compressor units should be used to regulate cooling water flow, thereby preventing sweating of lines, providing cooling for removing latent heat after shutdowns, aiding in cold starts and holding optimum temperatures.

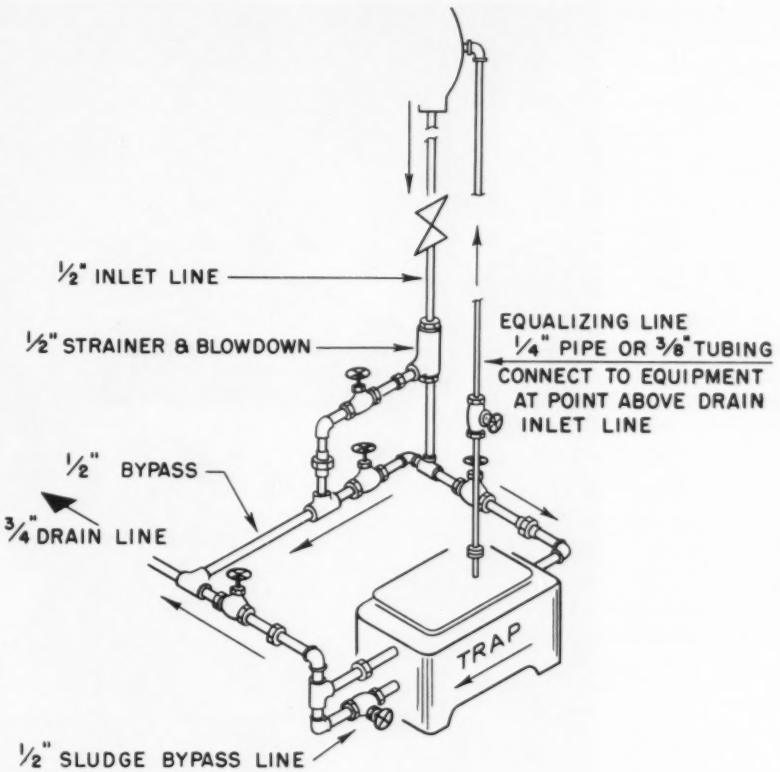
¶Air and water temperature indicators should be liberally installed to provide a means of adjusting cooling-water flow for maximum efficiency, to indicate machine performance and provide a means of observing trouble as indicated by excessive heat.

¶Flow indicators should be placed on the outlet piping of heat exchangers to observe the flow of water and to aid in leak detection. (Bubbles will appear in the sight glass if the exchanger leaks.)

¶Limit controls should be used to stop the compressor when air-discharge or cylinder-water-outlet temperatures exceed safe limits. These should be of the manual reset type to prevent automatic restarts until the equipment has been placed in safe working order.

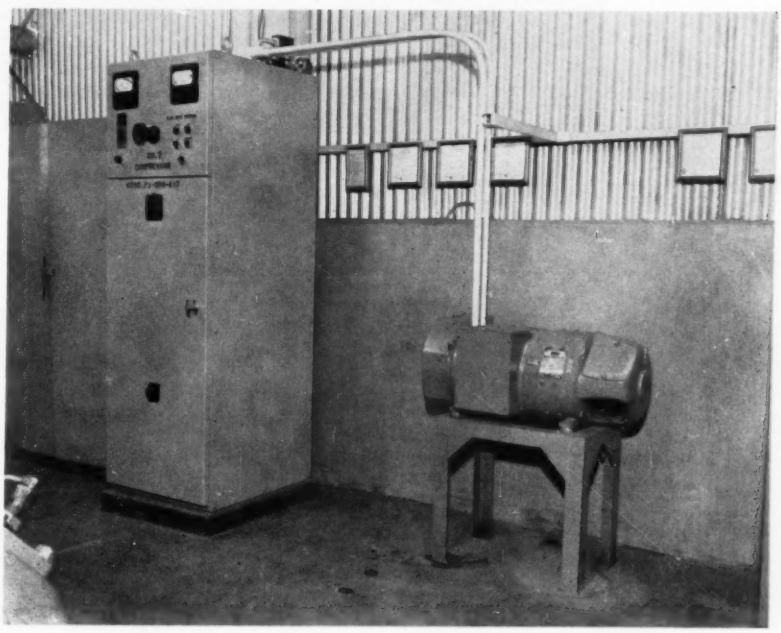
¶Drip legs, traps, and blow off's should be fully utilized; 'legs and traps must be installed at every low point and dead end. Keeping the system clean and free of moisture aids in system maintenance as well as extending equipment life.

¶Expanded metal guards should be used around discharge pipes, rather than thermal insulation which has a tendency to collect condensate and inhibit the free radiation of heat.



TRAP INSTALLATION

This sketch shows a typical condensate trap and its piping, as recommended by North American Aviation's Air Utility Committee. Condensate traps and drip legs are mandatory features of the aircraft manufacturer's air-plant design.



AN AID TO HOUSEKEEPING

Good housekeeping, of course, is a necessity to reduce maintenance and operating costs in an air plant. North American's Air Utility Committee has found that elevating motor generators on angle-iron stands and setting switchgear on concrete base slabs promote better housekeeping. The floor can then be washed down and swept more easily and, in addition, the motor generators run cooler.

STEUBEN GLASS

MATERIAL — WORKMANSHIP — DESIGN

"If any of the three elements is deficient, perfect glass cannot be achieved."

S. M. Parkhill

IN UPSTATE New York, in one of Corning's most modern buildings, behind an observation panel, groups of highly skilled workers are fashioning glass with tools and methods that have remained essentially unchanged throughout the years. They are the craftsmen of Steuben Glass, a division of Corning Glass Works. What can be seen through the partition in Corning Glass Center is but one segment of a vast operation that blends science with art, and ideas with ideals. What is being done in this one small area is giving a measure of world prestige to American glass that it has not previously held.

Egypt during the eighteenth dynasty is generally given credit for making the first glass vessels. That was more than 3500 years ago, and although the process was known for centuries, it was slow in evolving. It was not until the beginning of the Christian era that the Romans discovered that hollow articles could be formed by blowing air into the molten glass. The methods and tools used, as recorded by Agricola in the sixteenth century and by Diderot in the eighteenth, bear an amazing resemblance to those of today. Use of air compressors is the basic difference, especially in most mass-production facilities. Steuben, on the other hand, depends pri-

marily on the lungs of the gaffers for air power.

The history of Steuben Glass is much less long than that of other similar manufacturers. In 1868, Amory Houghton moved his glass factory to Corning, N. Y. (He had established it as the Union Glass Company 17 years earlier in Somerville, Mass.) The major facilities of the company, now known as the Corning Glass Works, have remained there ever since.

Frederick Carder, an English glassmaker, came to Corning in 1903 to utilize, as had Houghton before him, the coal and sand deposits of adjacent regions. Carder's works was named Steuben in honor of the county in which the city is located. He produced what is known as "art glass" in a wide variety of shapes and colors, much of it directed at a broad consumer market.

Corning Glass Works purchased the company in 1918, first converting the furnaces to wartime demands and, later, forming the "Steuben Division of Corning Glass Works." This division reverted to the peacetime manufacture of glass in Carder's earlier style.

In 1933, Arthur Amory Houghton, Jr., great-grandson of the founder of Corning Glass Works and the youngest member of the Board, requested authority to study the potentials of Steuben. Permission was granted and the present company was formed, with Houghton as its president and Corning Glass Works, the sole stockholder.

"To produce crystal glass in the highest standards of design, quality and workmanship—glass which could rank in history among man's greatest achievements," was Houghton's aim. He realized that the necessary craftsmen were available and accustomed to working together. He knew too that the facilities and technicians of Corning Glass were at his disposal. Perhaps more important, he understood the necessity of developing an excellence of design. It was this third factor that caused him to call John Monteith Gates, a young architect and lifelong friend. Gates answered, joined the new company and is currently its vice president in charge of design.

Gates, in turn, sought the aid of Sidney Waugh, a sculptor, and the three men, all less than 30 years old at the time, met and decided on the simple, forthright design that has become synonymous with Steuben. Robert J. Leavy, who had long worked with the crews in the Steuben shops, was asked to join the group as its general manager, a position that he still holds.

Under the guidance of Gates, headquarters were established on Fifth Avenue, New York City, where the design personnel could benefit from the cultural opportunities available in the city. Shortly after the design department was formed in 1936, a series of exhibitions followed. From this nucleus of men, facilities and exhibitions, Steuben has enjoyed a steady growth, the only interruption being during the Second World War when Houghton, Gates and Waugh were in the armed forces and production almost ceased. Today, Steuben Glass is still located on Fifth Avenue, with the exception of the technical and production departments, which are quartered in the Corning Glass Center.

CRYSTAL, as applied to glass, is not the same as geologic crystal; it refers to glass with a high lead content, such as optical glass. There are many formulas for crystal. In the Steuben oper-

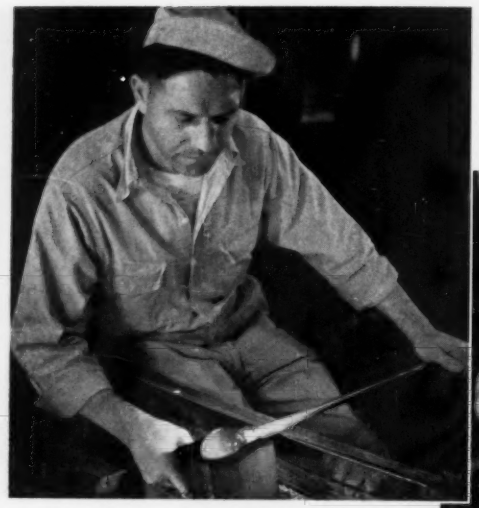
THEN AS NOW

The line drawing at the right originally appeared in Georgius Agricola's "De Re Metallica," illustrating a chapter on glassmaking. It shows a remarkable similarity between a sixteenth- and a twentieth-century shop, as illustrated at the bottom of this page.

The Story Of A Goblet

TO better illustrate the teamwork involved in the making of a single water goblet, the pictures on the following pages have been arranged to tell a story of their own.

1 **Every piece of Steuben crystal is formed around the few "glory holes" in the illustration above. Although fabricated in a different shape and of contemporary material, these reheating units are not unlike the sixteenth-century one shown in the drawing at the top of this page. Crucibles for melting the glass are out of sight at the left, and the annealing oven is located in the right background. The men seen around each of the heating units form a specialized "shop": a gaffer, servitor, gatherer, bit gatherer, stick-up boy and carry-in boy.**



2 After molten glass is gathered on a blowing iron, the gatherer (above) blows and shapes it until it resembles the basic form of the finished piece and is of uniform character. In this case, he is working on what will later become the bowl of the goblet. Because the stem of the finished pattern will have imprisoned twists of air, the rectangular mass of hot glass (center) is having slit-like indentations made in it. These will be covered with additional gathers, making air pockets. The rectangle is then marved, or rolled, into a cylindrical shape, with a wooden paddle. With a steel jack, a constriction is made at one end (right), and the opposite is rotated until the desired twist of the entrapped air is achieved.

ation, it consists of from 25- to 50-percent lead in the form of litharge. By comparison, common pressed-glass tumblers contain relatively no lead oxide. Optical glass contains about 44.5-percent lead.

It is the lead content that produces a bell-like ring when crystal is struck, and which gives it a smoothness to the touch. It is also the ingredient that gives Steuben pieces their distinctive weight—a specific gravity of 6.33, as compared with 2.25 for a borate glass. This is an important design factor.

Other raw ingredients of Steuben crystal consist of silica, a constituent of sand, and a flux of soda and lead. The flux causes the sand to dissolve and fuse when subjected to high temperatures, and gives the glass its particular color and hardness characteristics. For perfectly clear crystal, all the ferrous oxides must be removed, as must all other foreign matter. A nearly perfect colorless glass is left.

Ingredients of Steuben glass are rigidly controlled, both as to quantities and qualities; the crystal itself represents one of more than 50,000 different formulas developed by Corning Glass. The mixture, called a batch, with cullet (scrap or broken glass) added for smoothness, is placed into either a furnace or crucible. The latter is more generally used for crystal.

The crucibles are preheated for 5 to 12 days, until a temperature of 1000° to 1300°C is attained. They are then fire-hardened for another 12 to 36 hours and glazed on the inside with molten glass. Then, the batch is melted within them, refined in its liquid state and cooled. The length of time and the temperatures necessary for these operations depend upon the type of glass to be produced. In general, the temperatures required range between 1300° and 1500°C.

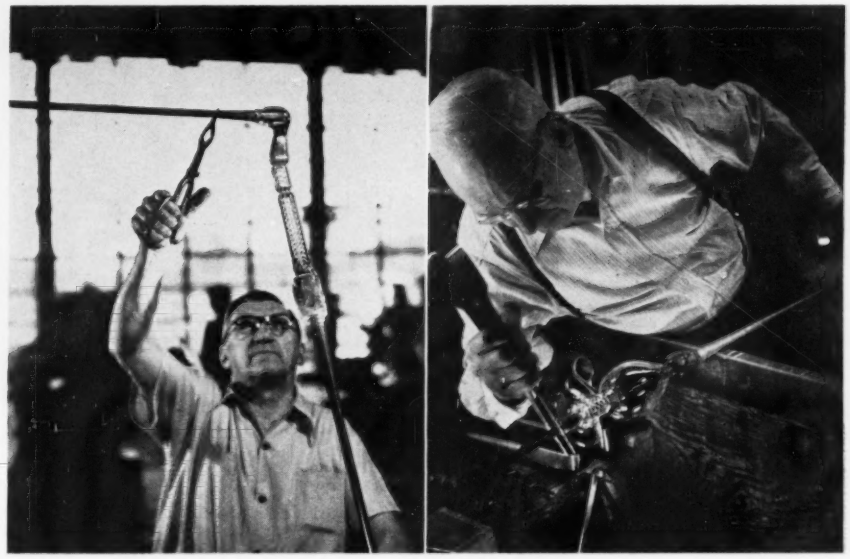
WHEN a piece of glass is to be made, the design staff works out preliminary sketches. When accepted, full-scale working drawings are made. Like all artists, the staff designers are limited by the medium. We have already mentioned the weight of the glass. In addition to it, the designers must remember that the craftsmen at Corning will be working with the glass while it is viscous and red hot. At the same time, the glass is constantly cooling and hardening. Therefore, the designs are often symmetrical and cylindrical so that worked pieces can be kept constantly moving. Further, the men who give the third dimension to the designs can never touch their material with their hands. They must rely upon wooden paddles, calipers, blowpipes and similar tools. The designers must constantly remember that they are working with a transparent medium upon which line, without color, must convey meaning. The size of the objects can never be too great, for the Corning operation is a manual one.

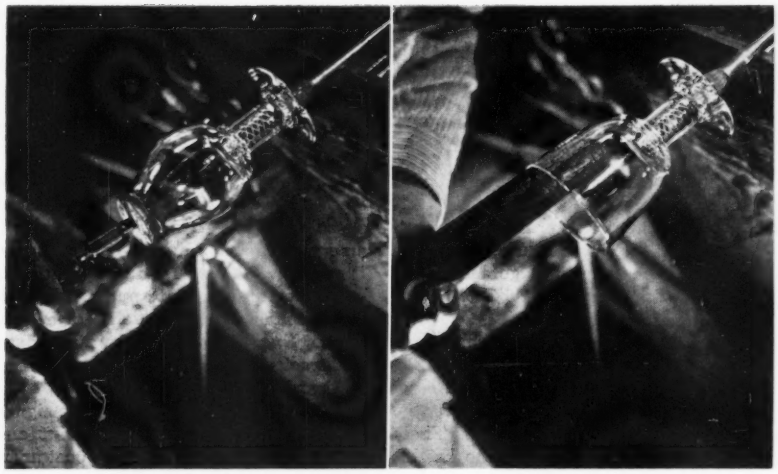
When the design is finished and the working drawings have been completed, the designer takes them to Corning, and a prototype piece is fashioned with the shop crew and the designer working in close harmony. (Clay or plaster-of-Paris models are not a good indication of the finished product because their properties differ so vastly from those of glass.) The sample is then returned to New York for further study and possible design modification.

Each approved model is sent to Leavy for approval of the production group. When organized, the founders established that the production department may never reject a proposed item for design reasons, nor may it change a design; rejections are based solely on either manufacturing or economic reasons. Some designs, although artistically satisfactory, thus can't be produced. This is especially true of items to be stocked.

Thus, designers are, to some extent, independent of the production technicians. This, supplemented with the limitations of the medium and the regulation binding the working crews to follow the design without adding ornamentation of their own, has given Steuben its tradition of basic, simple and straightforward products.

3 Once stretched and twisted, the servitor measures the exact length needed for the stem of a single goblet. Another gather is added (left) for the base. The gaffer then takes control of the group (right), and the work of the shop becomes his responsibility. He joins the stem-and-foot section to the bowl. In his right hand can be seen a steel jack for guiding the pontil bearing the piece to be attached. After the join has been made and slightly cooled, the pontil holding the bowl end is broken away with a sharp, striking motion. Excess glass is sheared away from the rim.





4 With a puff of compressed air from a cone-shaped nozzle (far left), the gaffer opens the top of the goblet enough to let him place a wood jack into the soft bowl. By rolling the glass on the pontil, the bowl is stretched into a symmetrical shape (left). Measurements are constantly made with calipers. A carry-in boy is ready to take the piece to the tunnel-shaped lehr as soon as it is formed. At the oven, it will travel at a controlled speed on a continuous belt until it is cooled. This relieves any internal strains that may have frozen into the glass. The time required for annealing depends on the thickness and size of the object.

Regular production includes about 200 items, each selected for its design standards and sales potential. A very few of these have been retained since the reorganization of the company in 1933, and the outlook for their remaining for a number of years is excellent. Most have had a shorter existence. Sales records are carefully checked, and similar items compared. If two similar pieces are listed in the stock, the public's buying habits may direct which shall be retained and which shall be discarded. Since the reorganization, an average of but twelve new stock items appear each year.

GLASSWORKERS have always been held in high community respect, even ranking with nobility in some pre-Christian eras. Their greatest crime would be the divulging of professional secrets to rivals. Out of this tradition grew the famous European schools of Orrefors, Baccarat and Lobmeyrs. Following their established practice, the Steuben craftsmen take each glob of glass in turn, blowing and swinging it into shape, cutting and reshaping it. They work as a well coördinated team with only experience and the designers' models to guide them.

Each team, or shop, working around a "glory hole"—an auxiliary furnace in which the worked glass is constantly reheated to maintain its plasticity—consists of from five to seven men. In charge of the group, and responsible for the finished piece, is the *gaffer*—an Old English corruption of the word "grandfather." His name, as do some of the others, reflects the traditions and history of glassmaking. At one time, it was the grandfather who guided his family in the production of glass. The gaffer joins and shapes the components of a workpiece, attaching each to the main portion. The man who gives the gaffer

5 When removed from the lehr, the foot of the goblet is polished and ground (top left). A shallow depression will remain where the pontil rod was removed, a sign of hand-blown glass. Next, if required, it is engraved. After the piece has passed a rigid inspection, "Steuben" is signed on the bottom with a diamond point (left). The finished goblet, with the other pieces of the same pattern, can be seen in the photograph above.

his glass is the *servitor*. He delivers it on a pontil, a solid steel rod with a serrated tip. The *gatherer* takes the glass from the furnaces on a 4- to 6-foot-long blowpipe, in much the same way as honey is scooped from a jar with a knife, shaping it with a cherrywood paddle and woodjack, a 2-pronged fork with cherrywood tips. The mass is evolved by a rolling motion across the arm of the gatherer's bench. Swinging elongates the mass; spinning flattens it. The *bit gatherer* has a similar task, but as his name implies, the quantities of glass he withdraws are considerably smaller. These bits are given directly to the gaffer by a *stick-up boy*, who holds them until they are needed. A finished piece with such added decorations as handles and the like is called a "gaffered piece." When the piece is finished, a sharp blow against the end of the pontil frees the glass, and it is carried in a padded, forked rod by a *carry-in boy* to a specially constructed, tunnel-shaped annealing oven, or lehr. Here it is placed on a moving conveyor and is passed through the oven at a controlled rate for progressive cooling. This eliminates any strains that may have been in the glass while it was being worked. Depending on the size and thickness of the piece, this process may take from several hours to several days.

(To understand better how these men work and the tools they use, a description of the making of a goblet is pictured in *The Story Of A Goblet* that begins on page 15.)

Every piece of Steuben is handmade in a similar fashion. Strict quality control is maintained from the mixing of the batch to the final working. To many, this is not seemingly true. There can be seen a difference in the height, for example, of the components of a set of water glasses. The perfection in which Steuben is interested, however, eliminates what it considers more serious faults, including wavy glass, uncontrolled bubbles, lopsidedness and misinterpretation of designs. Glass that does not meet the rigorous standards is broken.

The lehr is not the last production step for some of the pieces; they must be engraved. The men who practice this rare and difficult copper-wheel work, like the glassmakers, are schooled in European glassmaking traditions and have served long apprenticeships. Following a full-scale working drawing and using copper wheels of various sizes and thicknesses, they painstakingly carve the designs into the objects by pressing the glass against the wheels, rotating in high-speed lathes. To facilitate the work, emery powder in a linseed-oil suspension is added. The result of this operation is a shallow intaglio that appears, through optical illusion, as low relief of a gray color. Engraving may take many days and weeks; for some of the larger pieces, the work may require months.

When completed, each item is signed "Steuben" with a diamond point and is sent to showrooms and customers throughout the world. There are a few retail shops, each appearing like the others because of a uniform architectural and interior design. Each is planned to display the crystal to its best advantage. Built in 1951, the Steuben shop at the Corning Glass Center, for example, has deep blue carpeting on the floors, the shelving is of thick glass, frosted on the bottom and front sides. Light from behind dark blue walls shines into these glass shelves and up through the bottoms of the pieces on display. Other than pin-point ceiling lights, this is the only illumination. Each of the shops is similarly constructed, and a careful control is maintained over the standards of the stores licensed to display and sell Steuben.

THE BLEND OF TALENT

Gopal Ghose, famed Indian artist, submitted the drawing of monkeys, as shown at the left, as one of many designs offered by Asian artists for the current collection. The Steuben designers selected it, along with 35 others, because they felt that it would lend itself well to crystal. Then, a form was designed to take the drawing. As can be seen in the photograph directly below, a slight rearrangement of the drawing was necessary to conform with the contours of the piece. From the sketch, engravers patiently reproduced the drawings with copper wheels, linseed oil and emery powder. The 16-inch-high, cone-shaped piece is illustrated at the bottom. Each design in the collection is equally well-suited to the drawing engraved upon it; and the entire group is a tribute to the joint efforts of artists, designers, craftsmen and production and technical personnel, as well as a blend of Eastern art forms and Western working practices.

STEUBEN also makes two types of glass pieces other than those for the retail market. One is that typified by the Queen's Cup, given by President Eisenhower to Queen Elizabeth in commemoration of her visit to the United States. (It is pictured on page 14 of this issue.) Designed by the sculptor, Bruce Moore, it rises 14½ inches from its four scrolled feet to a crown-shaped finial. The whole is engraved with the flora and fauna of Virginia, reminiscent of Her Majesty's visit to the Jamestown Festival in that state. The original is in the possession of the Queen, a replica can be seen at the Steuben showrooms in New York. There are no others, and none will be sold. The Metropolitan Museum, the Louvre and the Victoria & Albert Museum are among the many institutions that include examples of engraved Steuben crystal in their permanent collections.

The third major activity at Steuben, and that which has raised the name of the company to its prominence perhaps better than any of its other activities, is the development of glass collections. The stated aim of these exhibitions is to "create works of art in crystal where true artisans develop the imaginative conceptions of great artists." A more practical result of these collection pieces is that in striving for new forms, the designers often develop shapes that can be applied to the retail group.

The first of the collections was shown in New York in 1940 and was called *Designs in Glass by 27 Contemporary Artists*. The second, *British Artists in Crystal* (1954), developed from the first. Although limited to artists of one country, it utilized the talents not only of painters and sculptors, as did the first, but that of engravers, silver workers, stage designers and the like. The current collection, *Asian Artists in Crystal*, was first shown 2 years ago. Since then, it has travelled around the world.

Such a show requires years of preparation. For the current one, work began in 1954 when Karl Kup, of the New York Public Library, was commissioned to seek out the work of the Asian artists. Extensive trips throughout the East, beginning in Japan, and continuing through Korea, China, the Philippines, Vietnam, Indonesia and ten other Eastern nations, yielded hundreds of designs. These were returned to the New York studios and carefully evaluated for their applicability to the crystal medium. When the final selection had been made, the designers went to work until just the right glass form was found for each design.

The 36 forms in the Asian artists group typify Steuben. They are a blend not only of the East and West, but of drawings and glass, and above all, the talents of designers, artists, craftsmen, production men and technicians. Everything made by Steuben, whether a set of goblets, official gifts, purely decorative pieces or collections, represents a combination of these skills and understanding.

Subaqueous Pipelines

Ruel McDaniel

WHEN the oil industry began drilling wells into the bottom of the Gulf of Mexico nearly 10 years ago, only a few people gave much thought to the problem of transporting the oil from sea to land. The industry was too involved in the new methods and equipment necessary to bring in offshore wells. Oilmen believed that their first task was to drill the wells.

In the small coastal community of Port Lavaca, Tex., however, an aggressive young man was thinking a great deal about the problem, and making plans to do something about it. He was "Sammy" Collins, now head of Collins Construction Company, a firm that specializes in laying underwater pipelines anywhere in the world. The beginning of this year found him with major submarine pipeline jobs in progress in such diversified spots as the Persian Gulf, India, Ghana, Louisiana and Texas. A great deal of the success of the firm is based on the use of compressed air.

Collins knows the oil business. He was born in 1913 at Beaumont, site of Texas' great Spindletop oil field, and his first job was as a roustabout on an oil rig. He proceeded from that to gauger's helper, roughneck, driller and finally rig superintendent. He then switched to pipelining and not only learned the rudiments of trenching and laying pipelines, but also the problems facing the then comparatively young pipeline industry. One of the greatest was that of crossing turbulent streams and tidal waters. As he worked on pipelines, he studied the problems and eventually developed some ideas to overcome them.

Upon these theories, he founded his own submarine pipeline business 10 years ago. The first contract awarded the firm was a hurry-up job for Aluminum Company of America. Alcoa was faced with numerous lease expirations on valuable gas-producing properties in Lavaca Bay, near Port Lavaca; it was vital that it begin utilizing gas from capped wells or lose its leases. Only 30 days remained in which to build a network of pipelines from the wells to shore, and on to the company's smelting plant at Point Comfort, Tex. Collins moved his equipment into the bay, hired a crew of 70 men and went to work. In 24 days, the line was completed, and the reputation of Collins was on its way.

Submarine pipe, lying unprotected, soon deteriorates as barnacles destroy the covering, expose the pipe and allow it to rust. On this first job, the pipe was not only put down as required, but buried a minimum of 18 inches using a Collins-invented trenching machine. It crawls along the floor of the sea, guided by the submerged pipe that is to be buried.

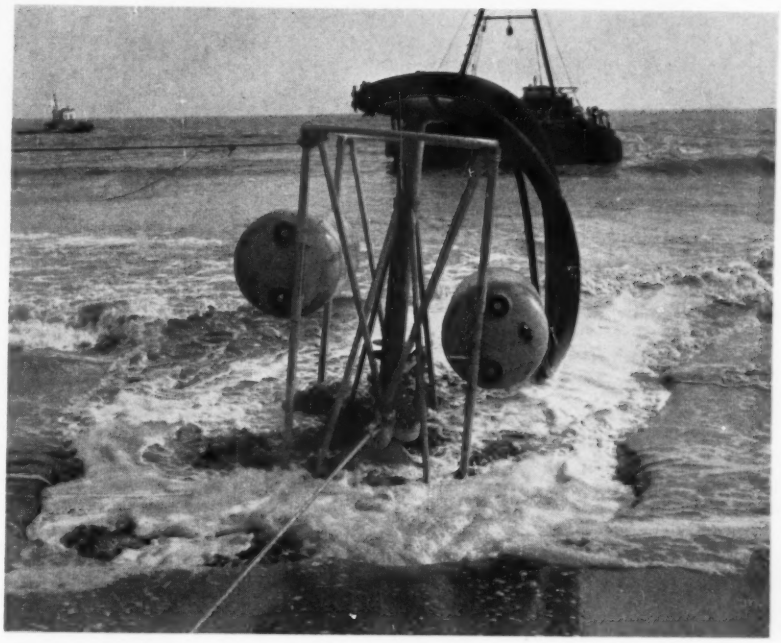
The trencher is a versatile machine that may be operated from either a barge on wide crossings or a land base at ones of limited width. It consists of a framework of welded piping, fitted with jet nozzles at the front and rear. There are two sets of nozzles: one for water, the other for air. Each is fed through the piping of the machine's own framework.

LAUNCHING AREA

This is the launching area for a submarine pipeline that was placed across Corpus Christi Bay in Texas. The pipe is moving along a Collins-designed launching cradle that consists of a series of rubber-tired dollies that support the pipe during welding, coating and launching. Floats are attached to the pipe by metal straps after the lines have been welded together and given their protective outer layer.

SUBAQUEOUS TRENCHING MACHINE

Air and water jets at the front and rear of the unit's base (right) cut trenches for burying submarine pipelines. The water jet loosens the material in a 3- to 4-foot path below the welded pipe frame, and the air flushes the material upwards and away from the trench. The machine here is working its way up the shore at Seal Beach, Calif., during the installation of a pipeline for Monterrey Oil Company.



The water jets are set in a pattern designed to cut and flush out material below the frame in a 3- or 4-foot swath. The air jets aerate this cut material, which becomes fluid, and set up a whirling action that helps carry the material away.

Two sets of four rollers each fit around the pipe to hold and guide the trencher. (The bottom rollers of each set are hinged. While the trencher is lowered to the pipe, they are in an open position; when the unit is over the line, they are then latched shut by a diver, thus securing the machine to the pipe.) Rollers are of rubber to prevent damage to the pipe's coating.

The upper section of the trencher carries two controlled-buoyancy tanks. These keep the unit upright and reduce its 6000-pound submerged weight to a positive buoyancy of only a few hundred pounds. For barge or land handling, the trencher carries jet pumps and compressors to feed the water and air into the nozzles.

Originally designed to operate in comparatively shallow water (a maximum of 200 feet), the trencher has been improved so that today the Collins outfit can lay pipe in water 2600 feet deep.

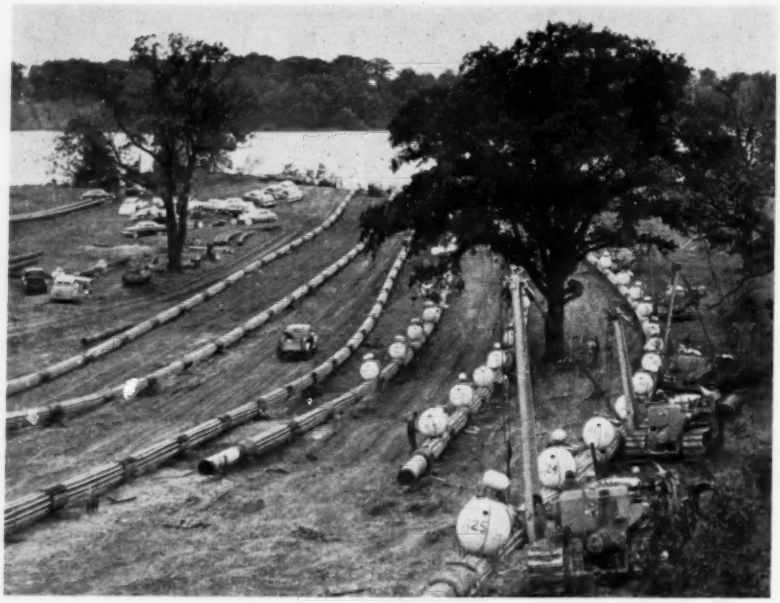
One of the most challenging jobs completed by the Texas concern outside its own locale was the Narrows Crossing of a Transcontinental Gas Pipe Line Corporation line between Staten Island and Brooklyn, N. Y. Collins handled the submarine phase. He used his trencher to cut a deep slit in the floor of the river, and brought into use other devices designed to operate with the trencher.

One of these was a launching cradle. It consists of a series of rubber-tired dollies that support pipe as it is welded, coated and prepared for launching. The dollies provide a cradle for several hundred feet of pipe welded together, the pipe's length depending upon space available at the launching site and the distance to be crossed. The second device was a float that is strapped atop the pipeline with steel bands. It provides buoyancy when the plugged pipe is drawn into the water.

The pontoons or floats, 20 feet long and 5 feet in diameter, are spaced to fit the buoyancy needs of the job. On the Narrows project, they were spaced about 110 feet apart. Air is forced into

READYING FOR A DIVE

This Collins Construction Company diver is preparing to descend from a pulling barge that tows submarine pipelines into place. His job will be to lock the trenching machine to the pipe so the undersea furrow can be cut. The Collins firm has buried such lines in many places around the world.



CROSSING NIAGARA RIVER

The first of three 600-foot strings of pipe is carried to the water's edge for the first crossing of the Niagara River (left). Collins pontoons have been installed on the pipes for buoyancy prior to their being hoisted by side-boom tractors. The three naked lines at the left are for the second crossing.

them to prevent their collapse under water pressure—the air pressure depending, of course, upon the depth at which the pontoons rest.

On the Narrows job, the pipe lengths were between 800 and 900 feet. The pipe was 24 inches in diameter and weighed 561 pounds per linear foot. Once in the water, it had a negative buoyancy of 203 pounds per foot, and as the pontoons came into action, the weight was reduced to about 7 pounds per foot. This made the pipe comparatively easy to handle and greatly reduced the "drag" of an 800- to 900-foot length as it was pulled toward the opposite shore.

As the rear end of the welded pipe length neared the edge of the water, the movement was halted long enough to weld another section, of similar length, to the preceding piece.

The pontoons were connected by, and attached to, a cable extending along the line to the operating base. When the pipe was in the trench and ready to be settled, a workman pulled a cord and automatically released the pontoons from the settled sections of the pipe. The buoyant pontoons shot to the surface, and men in boats retrieved them for the next job.

On this and similar crossings, Collins' men used two powerful winches. The larger of the two, called the Seamaster, is capable of pulling 1,320,000 pounds, or thousands of feet of buoyed pipe. Each winch, powered by six diesel engines is equipped with torque converters and Torquematic transmissions, enabling the operator to shift gears under full pulling load. Each has its own compressor, and all controls are operated by compressed air. Crewmen at these pulling stations talk by shortwave radio with the men on the barge and the launching sites.

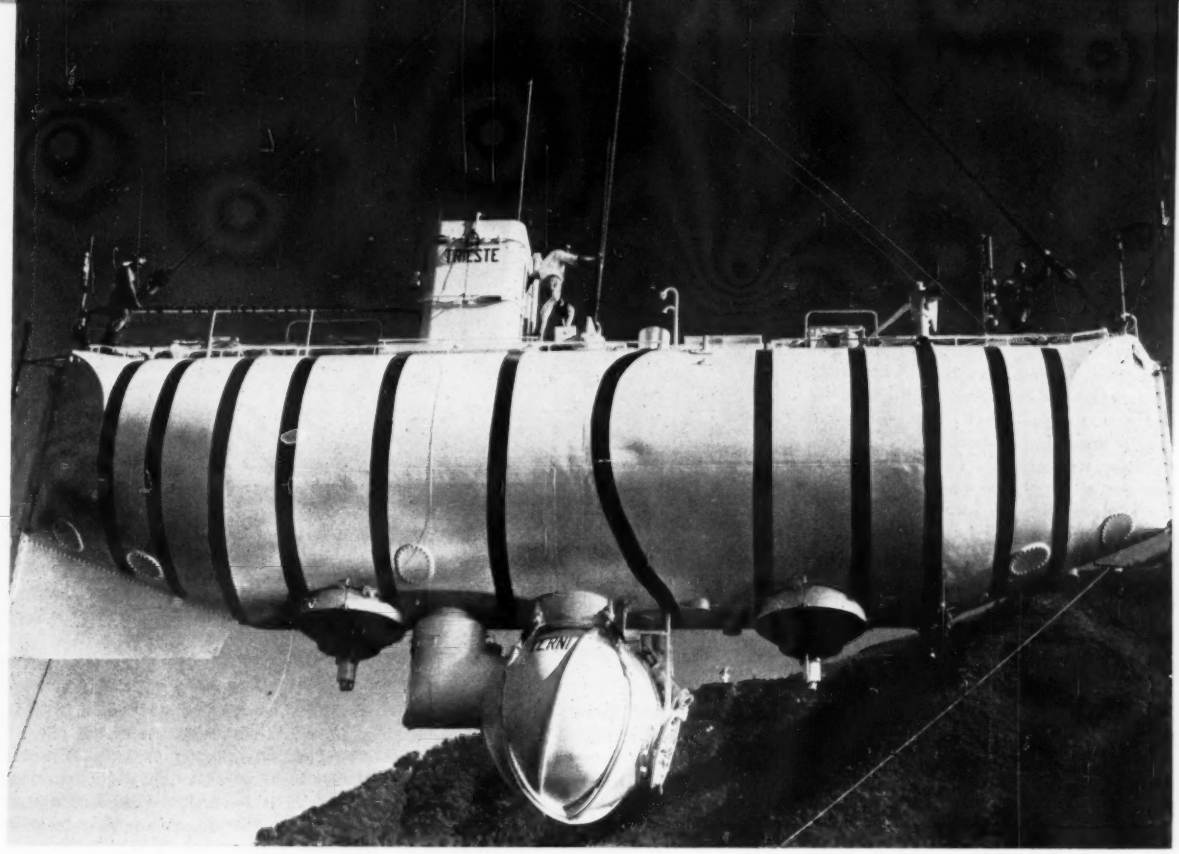
Another interesting job performed by the company was the crossing of the Straits of Mackinac, connecting Lake Huron and Lake Michigan. The concern laid 20-inch pipelines across 4 miles of extremely hazardous water in 65 hours and 5 minutes. The job was for Lakehead Pipe Line Company, and Merritt-Chapman & Scott was general contractor. This line was put down as deep as 250 feet. Methods similar to those used in the Narrows crossing were utilized, but the 2-inch pulling cable was buoyed every 2500 feet by drums 11 feet long and 36 inches in diameter.

Collins' jobs have not been limited to river and bay crossings. In 1954, the company laid a 12-inch sea-loading line 2 miles into the Atlantic Ocean, off Ghana, in conjunction with Taylor-Woodrow, Ltd., of England, general contractor for Socony Mobil Oil Company. The line makes it possible for oil tankers to tie up 2 miles from land in 50 feet of water, and pump oil products ashore from that position. Pipe sections, 1400 feet long, were welded together. Buoyed by pontoons placed every 100 feet, they were pulled toward the loading platform by the powerful Seamaster winch.

Another job that helped establish the firm's international standing was the 90,000 feet of pipeline laid from Pir Pau, on the mainland of India, to Butcher Island in the Bay of Bombay. The job consisted of installing seven lines ranging in size from 8 to 24 inches in diameter, in waters where tides as great as 18 feet were encountered.

SEAMASTER WINCH

The roof over this large Seamaster winch serves as a heliport. The winch, installed on a vessel called a pulling barge, is capable of towing 1,320,000 pounds of buoyed pipeline to a burial site.



OFFICIAL U. S. NAVY PHOTOS

SEA-GOING BLIMP

The main parts of the "Trieste" can be seen in this view showing the Bathyscaph suspended from cables. The 11-ton gondola is made of 3½-inch-thick steel. The buoyancy balloon carries gasoline rather than a gas, but operation is essentially the same as that of a blimp—ballast being dumped to rise.

Piccard's Bathyscaph

Submersible Has 20,000-Foot-Depth Range

WITH the development of a new type of underseas vessel, Auguste Piccard has made possible the exploration of parts of the earth's surface never before seen by man. Most of this planet —about three-fourths of its area—is covered by oceans, and of the floors of these vast bodies of water, we know comparatively little.

During the past 2 years, a group of United States and European scientists have made many dives into the Mediterranean Sea with the aid of this underseas vessel, named the *Trieste*. Financed by the U. S. Office of Naval Research, the Piccard Bathyscaph, as it is known, has proved its dependability by successfully carrying crews of two to depths of 10,000 feet and more. There are two of these diving equipments in use at the present time, both of approximately the same size. One is the *Trieste*; and the other, a French vessel known only as *FNRS-3*.

The Bathyscaph represents a major advance into the field of underwater exploration because it has overcome the limiting effects of the great pressures of the depths as well as being independent of life lines to the surface. The present vessels have a maximum vertical range of approximately 20,000 feet beneath the surface. There, the pressure is about 9000 psi.

The new Piccard development should not be confused with the Beebe Bathysphere, nor with a submarine. Its action is different in vital ways from that of either of these, yet it resembles, in many respects, a combination of the two.

As can be seen in the accompanying illustrations, the Bathyscaph is a dirigible-like device consisting of a float from which is suspended a gondola or spherical observation cabin. The float is the means by which the buoyancy of the craft can be regulated, and instead of being filled with a gas, is filled with gasoline, a fluid having a specific gravity about 70 percent that of water. The float is divided into ten compartments, and unlike submarines, is not subjected to great pressure variations. Holes in the underside permit the sea to flow into the chambers, thereby equalizing pressure.

In addition to the gasoline compartments, there are two air chambers in the Bathyscaph buoyancy "balloon." Water is taken into these to start the descent to the ocean floor. As the craft sinks, the increasing pressure compresses the gasoline enough so that the buoyancy is markedly decreased and the rate of descent increases. To slow this, the craft carries about 10 tons of iron pellets as ballast, some of which are jettisoned.

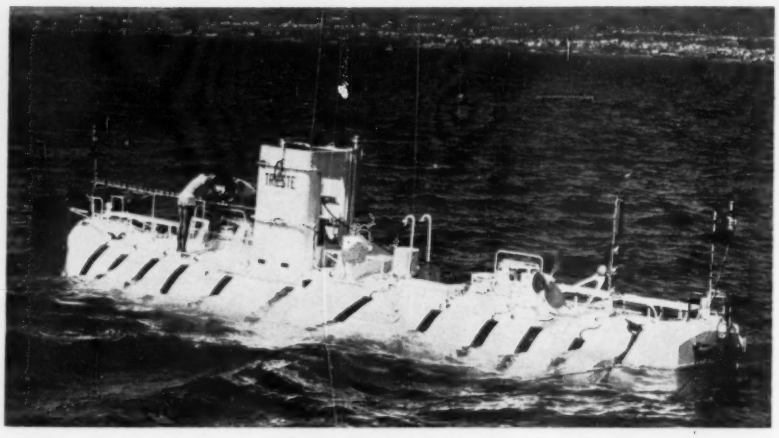
Once at the level desired, the Bathyscaph has a limited horizontal range of travel of approximately 100 feet, propulsion being furnished by twin propellers powered by battery-driven electric motors.

The passenger gondola weighs about 11 tons and is 6½ feet in diameter. Spherical in shape, the compartment has walls of steel more than 3½ inches in thickness. Carrying an oxygen supply

sufficient to last both passengers 48 hours, the gondola has two cone-shaped windows giving a wide-angle view of surroundings. Mercury-vapor flood lamps are included, along with a camera with electronic flash equipment, a 600-foot-range echo sounder and a telephone system that provides direct surface-to-cabin communication. The telephone works on a directed sound wave principle.

The craft can rise to the surface by its own buoyancy when enough of the iron-pellet ballast has been jettisoned. The method of releasing weight is novel and virtually foolproof. The pellets are held in special open-bottomed chambers by electromagnets. To release them, the power supply to one or several of the compartments is interrupted, thereby causing the magnets to drop their load. The system "fails safe" in that if something should go wrong with the power supply, the craft will lose all of its ballast and rise to the surface immediately. Because of the heavy steel walls of the gondola, the pressure within remains at atmospheric levels, thus no decompression period is required when surfacing.

The *Trieste* and its French counterpart are considered merely "trial balloons." Subsequent models, some of which are now well into the planning stage and one of which is under construction by the French, will have greatly increased vertical and horizontal ranges. Some consideration is being given to the use of lightweight lithium instead of gasoline as the buoyancy medium. Means are also being sought to reduce the weight of the gondola. Future models are sure to expand greatly man's knowledge of the deepest parts of the ocean: indeed, it is reported that the French Bathyscaph now under construction should have a vertical range of about 35,000 feet, or equal to the deepest trenches in the ocean floor.



READYING FOR A DIVE

Shown while being prepared for another descent to the bottom of the Mediterranean Sea, the "Trieste" resembles a small submarine when afloat. A tubular passageway through the buoyancy balloon leads to the gondola suspended below. On the deck can be seen the twin screws that propel the Bathyscaph in a horizontal plane. Future models will have greatly improved range, the present vessels being capable of only about 100 feet.

THE FLYING SYRINGE

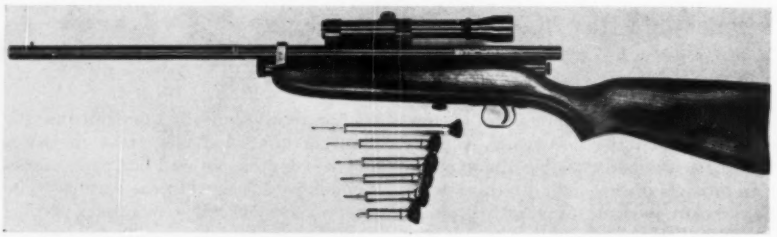
THERE'S a new type of hunter afoot in the world today. Of the "bring 'em back alive" school, the tools of his trade are a special adaptation of an air rifle, a drug and a flying syringe. The drug is nicotine and the syringe, an ingenious device that unloads itself on contact when fired from the gas-powered weapon. The hunter's quarry ranges from Georgia swampland deer to the mystic "abominable snow man" of the high Himalayas. Behind the drug, the syringe and the gun lie considerable research and a fascinating story.

The story began in 1947 when J. A. Crockford, of Georgia's Game & Fish Commission, worked with J. H. Jenkins, a wildlife expert, to trap some deer in the swamplands of south Georgia. The deer were plentiful in the swamp that year, but scarce in the good deer country further north in the state. The two attempted to balance the deer population by shipping some of the animals north.

They didn't have much luck. Regular deer traps didn't work too well, so they tried to find some better way of taking deer alive and unharmed. Among the methods discussed was the one South American Indians have used for centuries: blowguns firing darts smeared with curare, a paralytic poison. They reasoned that it might be possible to adjust the dosage so that the animals would be knocked out, but not permanently damaged.

The press of other duties interfered, however, and it was not until 1954 that serious research began on the project. Crockford received a distress call from the owners of Ossabaw Island, just off the Georgia coast. There was a combination of too many deer and a serious drought. The deer were thin and getting thinner, and the possibility of mass starvation was not remote. Crockford answered the call, trying to take the deer first with nets and then with box-traps. After repeated failures, he remembered Jenkins and their discussions about the curare poison method.

Jenkins, by this time a Ph.D., teaching wildlife management in the School or Forestry at the University of Georgia,



PHOTO, UNIVERSITY OF GEORGIA

SYRINGES AND LAUNCHER

The production model of the gas-powered syringe-firing gun is shown in this view along with the family of hypodermics that can be used with it. The weapon is made for Palmer Chemical & Equipment Company by the Crosman Arms Company. The "ammunition" is of .50 caliber, and the accurate range of the gun is about 50 yards.

agreed to help if someone were brought in that could help with research on the drug. Dr. Seldon Feurt, an associate professor of the School of Pharmacy, was persuaded to participate.

With a great deal of laboratory work behind them, the three set out to field test their drug-laden darts and a gun improvised by Crockford. The latter was a Bazooka-like arrangement—a huge weapon, fired from the shoulder, that utilized giant rubber bands cut from inner tubes of tires as the propulsive force. Lacking a safety device, it was as dangerous as it was spectacular. It was also awkward, being so big that it practically filled their jeep.

This phase of the project came to an abrupt end with the discovery that, although curare worked very well under laboratory conditions where the exact weight of the test animals was known and oxygen resuscitation equipment was handy, it didn't do so well in the field. The problem of carrying oxygen tanks and the fact that too many deer died, made the task seem insurmountable.

The group then enlisted the aid of Dr. Frank A. Hayes, of the university's School of Veterinary Medicine. After the brief period in which previous experience with curare was carefully investigated, the group turned to a study of strychnine. This drug causes a paralysis in animals that is generally fatal. It can, however, be controlled with an antidote, if the remedy is administered quickly enough. While preliminary laboratory tests with the new drug were complete, Crockford returned to his home workshop to try to modify a Crosman air rifle so that it would fire darts instead of pellets. He succeeded in that and also in turning out satisfactory darts. These had cotton cord tails that could be dipped in luminous paint so that night hunters could follow their flight. In the summer of 1955, the air gun-dart-strychnine system was tried. On the morning of August 1, they captured and successfully revived their first deer. In subsequent tests, a few more were taken, but some were killed because the antidote couldn't be administered quickly enough. A number of other drugs were then tested and, to make a long story short, the group finally tried nicotine, almost as a last resort.

Nicotine is one of the most toxic of all drugs, acting with a rapidity comparable to cyanide. It markedly stimulates the nervous system, then paralyses the nerve cells. It causes dizziness, disturbed hearing and vision, mental confusion and marked weakness. The blood pressure falls, breathing is difficult and the pulse is weakened. However, inasmuch as nicotine is rapidly destroyed by the body, death can be averted if the patient can be tided over the interval necessary for detoxication. Artificial respiration was indicated.

Test animals reacted to the drug just as the text books reported, but they didn't die. Nicotine would knock out a goat in a minute. Five minutes later, even without artificial respiration it would be back on its feet. Within 30 minutes, no ill effects could be noted. The action seemed, indeed, very similar to that of a strong cigar on a small boy.

On the next two test trips to Ossabaw Island, fifteen deer were taken without a fatality. Then the group concentrated on the gun, Crockford making major improvements in its accuracy and range.

With success came numerous inquiries into the weapon's suitability for taking alive larger animals including feral or semiwild cattle and swine, as well as jungle animals including elephants.

Experiments revealed that it was impracticable to use darts because a dart large enough to carry sufficient drug to calm an animal weighing more than 200 pounds was large enough to sometimes inflict permanent, or even fatal, damage.

To extend the work called for extensive research into some type of hypodermic needle that could be fired from the gun and that would unload itself upon contact. Enlisting the aid of an Atlanta, Ga., businessman, H. C. Palmer, the research team finally made a syringe that worked. Essentially, it consists of a typical hypodermic with a piston that is forced through the barrel upon contact, ejecting the contained fluid into the target. Units of varying capacity were devised, delivering from 1 to 10 cubic centimeters of drug. Extensive testing followed on cattle, and it was found that even the most unruly bull could be calmed in a few minutes.

As "cow shooting" became normal practice on nearby Georgia farms, requests for guns and syringes poured in from big game hunters, from members of the International Geophysical Year expedition at the South Pole who wanted to take live seals, and even from the group that was scouring the Himalayas for traces of the ancient "abominable snow man."

The research group began to see even more uses for the flying syringes. They envisioned a safe and humane method of rounding up suspected rabid animals for test and treatment. They thought that perhaps veterinarians, often times delayed in treating animals that couldn't be caught, might find it of value. Furthermore, it was determined, the syringes could be loaded with almost any drug in solution so that a veterinarian with a "good shootin' eye" could treat his patients from afar.

With these application's growing in number, the group asked Crosman Arms for help in improving the gun, and valuable suggestions were received that resulted in a weapon that could propel the .50-caliber syringes accurately within a 50-yard range.

Guns and syringes are now available from the Palmer Chemical & Equipment Company, Atlanta. They are for sale only to veterinarians and to governmental agencies. Actually, the new weapon is more dangerous than conventional firearms because, if it is loaded with the proper drug, any hit may be fatal.

PHOTO, UNIVERSITY OF GEORGIA

INVENTORS AND THEIR QUARRY

From left to right, Messrs. Feurt, Hayes and Jenkins are shown with the production model of their syringe gun. At their feet is the rapidly recovering subject of a test of the weapon. The gun is expected to be of great aid in subduing feral cattle as well as rabid or otherwise dangerous animals. It may also be used by veterinarians to administer drugs from afar, saving a great deal of effort in running down and catching sick animals.

This and That

Energy From The Sea

An "ocean of expansion" lies ahead for Americans, with energy delivered from sea water. Instead of worrying about dwindling fossil fuel reserves and radioactive nuclear plants, power engineers will be able to supply the United States with free hydrogen fusion power from ocean water. Americans will be able to have an almost completely automated life at low cost before the end of the century, it was predicted at the recent National Power Conference in Boston, Mass. In looking into the future, it was added that even our homes will change beyond our conceptions today. Controls within the reach of easy chairs would regulate the warmth of the waters in swimming pools, cook meals, wash dishes electrostatically, dim luminescent walls and consult electronic memories about shopping lists and social and business obligations. In transportation, electric energy may, in some ways, replace petroleum. Frederick Kramer, a speaker at the conference, stated that the utility company that supplies all the power for these devices will be a "desirable neighbor, clean and quiet in operation . . . and all (of) its power source will be contained in a tank of water."

★ ★ ★

Duplex Aquatic Mousetrap

Self-Sett Mousetrap Company of Cleveland, Ohio, has taken to heart the time-worn phase, *build a better mousetrap*, and has devised one that is dependent upon neither poison nor electricity. Water is the lethal medium. The mousetrap is a self-setting one that is capable of catching more than 100 mice at a single setting and is intended for use in warehouses, food processing plants, grain elevators, restaurants, farms and the like. The trap is 15½x3x15 inches in size, and weighs 12 pounds. The water chamber holds 2½ quarts. The rodent is enticed into one of two entrances at the bottom of the trap by the smell of hidden food. Once the mouse enters the hole, he walks up and tips a seesaw-like ramp, causing a trap door on the entrance to close and set the trap for the next mouse. A tiny pinhole of light at the top of the trap lures the mouse into climbing a built-in ladder. Once on top, the mouse is attracted by another pinhole of light on the other side, and walks to it. The weight of the mouse causes the ramp on which it is walking to tip sideways. The rodent drops into the water-filled tank and drowns. Incidentally, the mouse never gets to the food lure. Three operations set the trap: filling the water chamber, inserting the bait tray and pressing buttons to open both doors. Each of the traps has its own duplex arrangement, with separate entrances, levers and ladders. Not only is the trap sanitary, for it can be dissembled in 5 seconds without hands contacting any part touched by the rodents, but it is essentially rust-free, since it has been fabricated of Republic Steel Electro Paintlok Sheets. Thus, all of the balanced parts work freely.

★ ★ ★

Skyscraper Is Rising In Germany

Germany is continuing her rebuilding program with the construction of a 26-story office building in Duesseldorf. It will be that city's largest, and one of the tallest in West Europe. Rising to a height of 290 feet, it will supply a working area for some 1200 employees. The building has the latest conveniences ranging from air conditioning to first aid and fire stations, roof gardens, etc. There will be a cafeteria and a 300-car cellar garage, and eight modern elevators will service all floors. Erection is being done by Phoenix-Rheinrohr A. G., and the architects were Dr. Helmut Hentrick and Dipl. Ing. Hubert Petschnigg.

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4429 Miles Of Defense Highways

Some 1286 miles of Interstate defense highways are completed, and about 3143 miles are under construction, according to a recent survey of state highways departments. The completed portion represents roads open to traffic. Texas reported the most completed mileage: 223. Others leading the list include Pennsylvania, Washington, North Carolina, Maryland, Michigan and Oregon. When completed throughout the United States, the network will consist of 41,000 miles and will amount to 1.2 percent of the total rural mileage in the nation, carrying about 20 percent of the traffic. It will connect more than 90 percent of all the cities in the United States with populations greater than 50,000. For automobile drivers, this will represent a reduction of car costs by about a cent a mile and will save nearly 4000 lives annually, it is estimated.

★ ★ ★

Carrying Gas Across The Atlantic

Floating vacuum bottles soon may be carrying gas from Texas to keep the home fires burning in Britain. American private enterprise and the British Gas Council have pooled their skills and come up with custom-built ships to haul liquid methane from the Gulf Coast to points on the Thames River. A prototype 7500-ton cargo ship is being converted and outfitted with special storage tanks insulated with balsa wood. There, liquid methane will be kept at temperatures of minus 250°F to prevent it from vaporizing. If the proposal is successful, it may provide a plentiful new source of economical fuel for energy-hungry Europe.

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Platinum Protects "Platanode"

A steel-hull Roamer Express Cruiser, that will eventually become "the most corrosion-proof vessel afloat," was recently christened *Platanode* at International Nickel Company's Corrosion Testing Stations, Harbor Island, N. C. Her name is in keeping with the platinum anode used in her electric anticorrosion system. Corrosion is stopped by applying a controlled electric current to the hull, neutralizing the current generated by corrosive action. Capac, as it is called, is installed on the new Forrestal-class aircraft carrier, *Independence;* the atomic submarine, *Triton;* and other large U. S. Navy and merchant ships. The *Platanode*, however, is the first steel hull small boat to be equipped with the system. For it, Charles Engelhard, Inc., modified and miniaturized the system now protecting the larger vessels. It uses about ⅓ ounce of platinum in the anode structure, and can be obtained at a price within the means of the pleasure-boating enthusiast. Electrical requirements are so small that even on an idle boat, the battery will operate the system for 3 months, it is said. The small boat equipment also is effective in protecting interconnected submerged metal parts of wooden hull cruisers. Protection is applied during mooring as well

Correction

An inadvertent transposition occurred in September's lead article, *West Delaware Tunnel*. To set the record straight, Paul DeMarco was employed as Concrete Superintendent, and John Carson, as Topside Labor Foreman. The contractor would also like to make mention of the fact that Arthur P. Chase was Project Engineer for the development period, and when transferred to another McLean•Grove job, was replaced by Guy Simoni.

as when under way, and the system may be used on new or old boats.

In operation, controlled current flows from the platinum through the sea to the hull. Current flow in this direction protects the hull, but could be severely corrosive to the anode from which the current enters the sea. Platinum, because of its exceptional corrosion resistance, easily withstands this severe service and makes practical the electrical method of corrosion control.

The small boat Capac equipment includes, in addition to the platinum anode, a reference cell and the necessary electrical equipment encased in a nickel-chromium stainless steel housing. Practically maintenance free, the encased equipment is located below the cockpit floor, accessible through the hatch. The minor current drain required is obtained from the battery with provision for automatic switching to shore-based power at dock side.

★ ★ ★

Petroleum Postage Honors

Coincident with the World Power Conference in Montreal in September, the Canadian government issued a 5-cent stamp in honor of the important role the country has played in the petroleum industry. It was a Canadian geologist by the name of Abraham Gesner, for example, who discovered kerosene in 1846 and established its use for illumination. James M. Williams, another Canadian, dug the first commercially successful oil well at Oil Spring Ontario in 1857, and Canadian enterprize in the refining of petroleum has became the basis for the industry throughout the world. The conference itself brought together some 1700 representatives from 52 countries to consider how the various sources of energy from heat and power might be adapted for the maximum benefits of mankind.

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Uranium Production Statistics

The U. S. Atomic Energy Commission has announced monthly and total statistics on domestic uranium production for the first 6 months of 1958. Included are figures on uranium concentrates, domestic ore production, rate of processing, ore fed to process, ore stockpiling, ore reserves and initial production bonus. The reserves were estimated to total 78,500,000 tons; receipts, 2,440,000 dry short tons; ore fed to process totaled 2,471,000 tons, with an average grade of 0.26 percent U_3O_8; stockpiled, 1,956,-531 dry tons; and a total of $1,026,724 was paid in initial production bonuses in the first 6 months of this year. As of June 30, there were eighteen uranium processing mills in operation, and several new plants were scheduled to go into production during the last half of the year.

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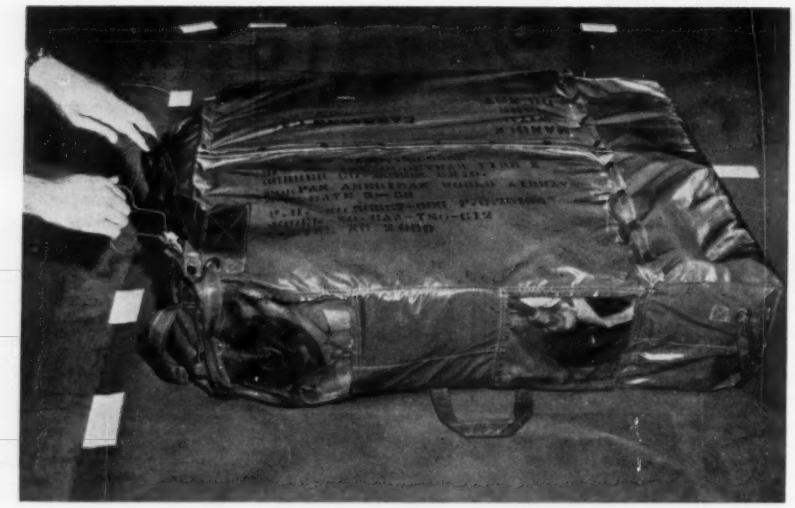
Another Use For Mylar

Because an engineering drawing represents a sizable investment of money and talent, newly developed drafting materials are being made of durable plastic film instead of the traditional coated cloth or paper. When subjected to continued handling and storage, drawings on conventional materials become yellow, frayed and worn—often making redrawing necessary. The new materials, based on Mylar polyester film, withstand wear and repeated abuse and reportedly won't absorb water, oil or grease. Soiled drawings can be cleaned readily. Because the film is tough, draftsmen can make four times as many erasures as on conventional materials it has been said. Several manufacturers are offering the material based on Mylar at a cost about equivalent with many other grades of cloth. Both pencil-and-ink and sensitized surfaces are available.

SHOWERS AT MISSILE SITES

Made of lightweight aluminum for easy portability, showers such as the one illustrated in operation, are finding good use at missile-launching areas. Developed by the U. S. Army's Engineer Research & Development Laboratories, the design was made by the Fire Fighting Branch. Effects caused by accidental contact with liquid rocket propellants are neutralized by a shower of water. To be doused, the user simply steps on the treadle. Pressure is furnished by two cylinders of compressed air, mounted on a skid, and water is released from a 100-gallon, 570-pound tank. The liquid is held at body temperature by ordinary truck flares, or, where open flames would be hazardous, by an electric immersion-heating unit.

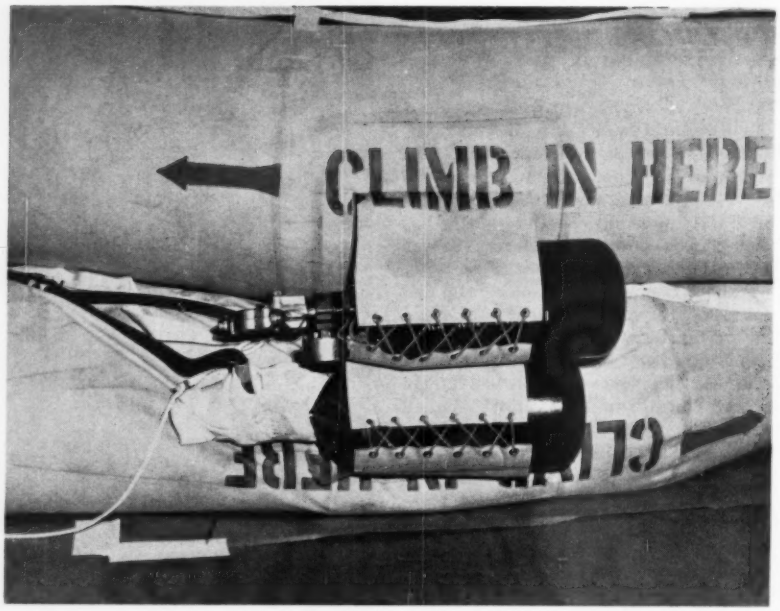


NINE SECONDS

The 25-man life rafts are easily inflated from this 1x3x4-foot package. After opening the protective flap (left) and pulling the handle, two 220-cubic-inch-capacity steel bottles (center) supply 3000-psig-pressure air to the Inflatairs. Each of these discharges the air through perforations in its spray ring. The inspirator thus compresses a larger volume of free air to raft-inflation pressure. The bottom illustration shows the raft, 9 seconds after the inflation process began. The canopy lends protection from the sun, and, if desired, its side vents can be lowered giving survivors complete protection from the elements.

Bottled Air Protects—

Overseas Travelers



AS STANDARD equipment on all DC-8's, Convair 880's and Boeing 707's and 720's slated for overseas flights, Walter Kidde & Company, Inc., is manufacturing 25-man life rafts. Flight crews of the airlines that are to operate the new aircraft will be indoctrinated in the use of the rafts. Training will be given by the airline concerned, often with the assistance of the U. S. Coast Guard.

The rafts are manually actuated and are made of 2-ply, 8-ounce, rubberized nylon. During the operation, two Inflatair units draw 3000-psig-pressure air from two 200-cubic-inch-capacity steel bottles. The air passes through pneumatic lines to the raft's Inflatair inspirators. At each Inflatair, it discharges through perforations in a spray ring venturi orifice. Free air is drawn along with the compressed air in ratios as great as 20 to 1, and this combined stream floods into the raft.

Each raft is equipped with fishing equipment, flares, first aid devices, signaling mirrors, dye markers, a flashlight, a knife, a sea anchor, rations of food and fresh water and complete accessory and emergency equipment necessary for survival at sea.

Prior to inflation, the rafts are packed in a protective, self-opening rubberized-nylon envelope. The entire package measures about 1x3x4 feet and weighs approximately 130 pounds when fully equipped.

EDITORIAL

The Lightweight Metal

AUXITE, rigorously defined, implies a chemically pure ore composed almost entirely of hydrated aluminum oxides and ferric iron. To many laymen, however, bauxite is the general term for clays that yield aluminum and as such, is thought to be the most plentiful ore in the world. At any rate, estimates put the aluminum content of the earth's crust at about one-thirteenth of the total, being surpassed in volume only by oxygen in combined forms, and silica.

Commercially minable aluminum-bearing clays are found in all corners of the world. Aluminum production, however, is concentrated in but a few countries. In 1955, the United States produced about 46 percent of the world's total, Canada about 18 percent, the Western European countries, also 18 percent, Russia and the satellite bloc, about 16 percent and the other countries of the world, 2 percent. In 1956, about 3,700,000 tons of primary aluminum was produced; in 1958, an estimated 4,600,000 tons will be turned out; and by 1960, total world production should total some 5,650,000 tons.

PRODUCTION methods, as developed simultaneously by Hall in the United States and Heroult in France, call for passing a heavy current through a mixture of alumina and cryolite at a temperature of some 950°C and in the presence of carbon. Usually the carbon is in the form of anodes and cathodes and serves to combine with the oxygen being given off, in the electrolysing current, by the breakdown of the aluminum oxide. The refined metal is collected and withdrawn at the bottom of the carbon-lined reduction vessel as a liquid, its melting point being 659°C.

The making of a ton of aluminum requires some 25,000 kwh, 2 tons of alumina and ½ ton of carbon. Derivation of alumina from bauxite requires another approximately 2 tons of ore as well as several tons of other chemicals. It is thus apparent that large quantities of material are needed, but that the principal ingredient may be said to be power. It is readily understandable that most aluminum producing plants have thus grown up in areas where large quantities of electricity are available at an economic cost.

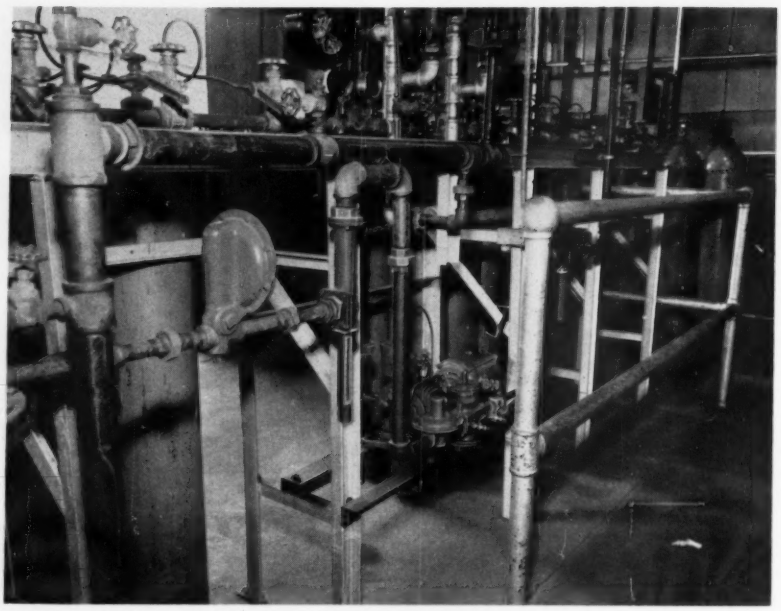
ALUMINUM is a trivalent element and combines readily with oxygen to form alumina, its only oxide. Paradoxically enough, it is this rapid oxidation that makes it possible to use aluminum for most of the tasks it performs today. Sheets or extruded forms of the metal rapidly form on their surfaces a thin film of the corrosion product. The film effectively inhibits further oxidation of the main body and also protects it against attack by a variety of other chemical agents.

ANODIZING is another technique that serves to make aluminum useful in this day. Essentially the method consists of making the aluminum an anode in an electrolytic bath and coating it with any one of a variety of protective or decorative films. Many buildings erected in recent years have been of anodized-aluminum curtain-wall construction and of a variety of permanent colors.

CHANGING markets have necessitated a great deal of research on the part of aluminum producers of late. One of the principal changes acknowledged by these firms is the coming of the space age. During World War II, the lightweight metal was in strategic demand for aircraft of all types. Even after the war, aluminum was vital to air defense. Now, however, with missiles and rockets scheduled to replace fighters and bombers in the country's defense plans, much of the aluminum diverted to these needs is making itself felt on the open market. Aluminum curtain-wall construction, the increasing use of the metal in automobiles (General Motors has announced that an all-aluminum engine has been successfully tested), and such innovations as the Fairchild aluminum bridge (a prefabricated structure utilizing basic principles of aircraft design) will, it is hoped, utilize aluminum surpluses in years to come.

WINNING aluminum from the soil, providing power facilities for its reduction to the metallic state and forming, fastening and otherwise finishing it are all jobs at which compressed air excels. Extraction costs have remained remarkably steady through the years. The price per pound in 1926 in this country was about $0.27. Currently it is selling for $0.24 to $0.25 per pound, in New York City markets. With steadily rising costs of labor, it is thus apparent that the industry has made the most of mechanical aids to production. Concentration on cost-cutting techniques as well as the utilization of more and more cost-saving equipment is definitely "on the books" according to the aluminum manufacturers. Soviet Russia is admittedly using its surplus of aluminum in its economic war on the free world. To compete successfully with subsidized Russian production, the aluminum companies say, will require a maximum effort on their part. It is expected that compressed air will play an important role in the development of more efficient processing and fabricating methods.

GASES SEAL ELECTRON TUBES



INSTALLATION VIEW

Mixing of nitrogen and hydrogen is accomplished by the Selas Proportion-Aire shown at the center of the illustration. The unit is installed in the cylinder room of RCA's Harrison, N.J., tube plant, and provides gas for sealing miniature electronic tubes. The two gauges visible to the right and left, above the device, are flow-rate indicators that show the proportion of each gas entering the mixture. Stand-by cylinders of premixed gas are at the right background.

DURING final sealing of miniature election tubes marufactured at Radio Corporation of America's Harrison, N. J., plant, a gas mixture is forced into the tiny electronic components. The gas—consisting of 70-percent nitrogen and 30-percent hydrogen—has an important job in the prevention of oxidation of the metal parts within the heated tube. Without it, the delicate metal sections would quickly burn out.

Until about a year ago, the plant purchased the gas premixed in standard 275-cubic-foot cylinders, and these were delivered directly to the tube sealing machines. The cylinders not only created a handling problem, but the gas was relatively expensive, costing $9.75 per 1000 cubic feet. Pure nitrogen sells for about $3.78 per 1000 cubic feet in bulk trailer loads, while hydrogen either can be manufactured inexpensively by the user, or purchased at $5.00 per 1000 cubic feet.

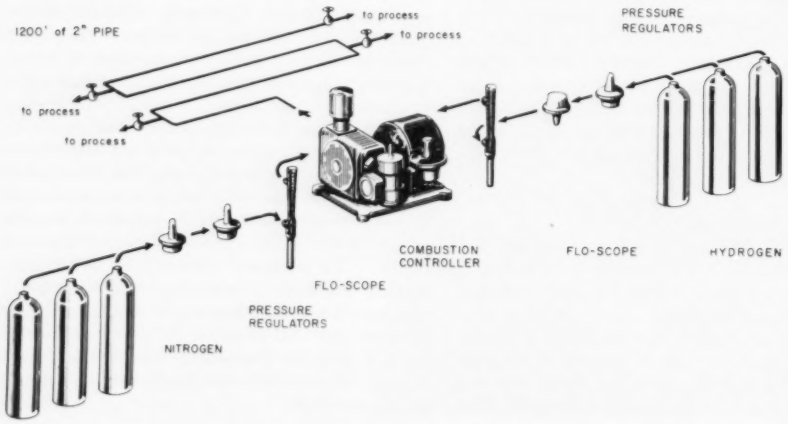
If the manufacturer mixes his own, the cost of the gas mixture drops to $4.15 per 1000 cubic feet, assuming the hydrogen to be purchased. This means a savings of $5.60 per 1000 cubic feet, or an impressive $5600 per million cubic feet, and represents a cost reduction of 57 percent.

With these facts in mind, the plant managers elected to install their own gas mixing unit—a device based on a Selas Model 5-C-5 Gas Combustion Controller. This machine has been used for some time to mix fuel gas with air in constant proportions to assure efficient combustion and to control furnace atmosphere during varying heat demands. The unit, adapted to the new use of mixing the noncombustible nitrogen and hydrogen for the electron tubes, is named Proportion-Aire.

The device consists basically of two components: a mixing valve and an electric-motor-driven compressor. Within the valve are a sleeve and piston, arranged so that the ratio between the two side port openings can be set to maintain the desired proportion of the two gases being mixed. Pressure regulators equalize incoming gas pressures. The sleeve rises and falls in direct proportion to the demand, increasing or decreasing the total quantity of both gases passing through, without changing the ratio. After the gases are mixed, they pass into the vane-type compressor that raises the pressure to 5 psig. A relief valve recirculates the mixture to maintain this pressure at the compressor discharge. The hydrogen and nitrogen supply lines are equipped with Selas Flo-Scope (flow-rate) indicators to check the proportion of each gas flowing at any given time.

Mounted in the cylinder room of the gas house, the mixing apparatus draws gas from bulk storage. This has eliminated the necessity of maintaining and manually handling large stocks of individual cylinders, as was done previously. The only cylinders present now are a few containing mixed gas for emergency use. The mixing equipment operates continuously during the day. At night, when less gas is needed, a switch shuts off the Proportion-Aire when pressure rises to 5 psig; it starts the unit when there is a drop to 4.5 psig.

RCA reports that the savings received from mixing the gas, rather than buying it premixed, paid for the equipment in less than a month. Beyond this, there has been a labor savings because gas cylinders don't have to be moved.



GAS-FLOW DIAGRAM

This drawing indicates the flow of nitrogen and hydrogen through pressure regulators and Flo-Scopes, to the Proportion-Aire (Combustion Controller), and on to the 1200 feet of piping in the system.

New Use For Blast-Hole Drill

ONE advantage of air-operated equipment is that its versatility often allows its adaption to jobs other than the one for which it was originally designed. In such situations, the problem often does not lie in the adaption, but in the recognition of possible new applications. Once discovered, mechanical modifications and refinements can always be devised. A New Jersey contractor has found this to be true, and his work has opened an entirely fresh concept in water well drilling.

Based on an Ingersoll-Rand Company patent of 1932, the Downhole drill has been utilized very successfully for blast-hole work. It is a percussion-type drill that is attached directly to the end of a drill steel. It follows the bit, as the name implies, down the hole. The operation is efficient because no energy is lost in transmission of power through long drill rods. Open pit miners, quarry personnel, contractors for highway programs and general construction projects, and submarine and dredging contractors have made use of the Downhole drill for sinking blast holes.

The Downhole drilling unit used in the following case was a newly introduced Drillmaster called the Trucm-3. It is mounted on a sturdy chassis, built by Crane Carrier Corporation, that meets all highway dimension requirements and travels at sustained normal highway speeds. Its air supply is furnished by a 600-cfm Gyro-Flo rotary compressor mounted on the vehicle. (Other types of Drillmasters are mounted on crawlers or have their own tractor mountings.) The Downhole drill is standard equipment on Ingersoll-Rand's Drillmaster, as are the compressor, tower and hydraulically operated leveling jacks.

Several years ago, the New Jersey contractor, using a churn drill, a type often applied in well drilling work, achieved a 120-foot well in 240 hours of operating time. He used a 10-inch starter bit and finished with a 6-inch bit.

Recently, he thought that the Drillmaster he was using for construction jobs might also be used for water well drilling, especially where the holes had to be placed in hard rock. With the Drillmaster and Downhole drill, at a point 100 yards from the spot drilled with the churn drill, he put down a 160-foot well in 20 working hours, producing 20 feet of 6½-inch hole and 140 feet of 4¾-inch hole. In other terms, the air-operated drill outperformed the cable tool by a 16-to-1 ratio.

In other instances, performance figures for the air-operated unit are equally impressive and show great time and money savings when compared with conventional types of water well drilling. The same contractor, for example, when working in granite and trap rock, put down a 575-foot water well in 2 weeks. At three different locations, including the time for three long moves, he drilled many wells that totaled 1893 feet of hole in 129½ hours. At still another site, he produced several more wells totaling 2400 feet of hole in 142½ hours. In a 3-month period, 50 wells of an average depth of 100 feet were drilled by the I-R unit. The average output has been estimated to be about 100 feet per day.

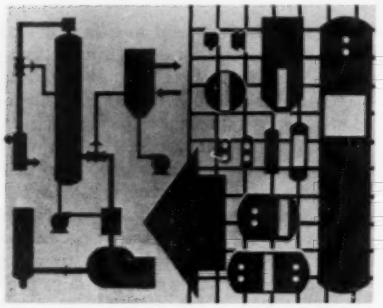
There are two principal reasons for the success of the Downhole drill and the Drillmaster mounting: design and set-up time. In the first, the entire force of the 100-psig operating air is exhausted through the bit to keep the hole clean. Even when the drill is stopped, all the air can be passed through the bit to blow away cuttings. Further, the Drillmaster being used with the Downhole drill in hard formations, can easily be changed to a rotary bit if soft rock should be encountered. Coupled with these design advantages, the set-up time for the entire rig is but 15 minutes, whereas churn drills often take 2 hours or more to be prepared for work.

ON THE JOB

At the site of the "contest" between a Drillmaster mounting a Downhole drill and a churn drill. The complete drilling unit is known as a Trucm-3 Drillmaster and is mounted on a highway-type chassis built by Crane Carrier Corporation. In this illustration, the worker is using an I-R air-operated grinder to sharpen a bit. The Gyro-Flo rotary compressor is clearly visible.

Industrial Notes

GRAPHIC SYMBOLS, cutouts and interconnecting flowlines have been standardized in a system that helps reduce design time, facilitate procurement

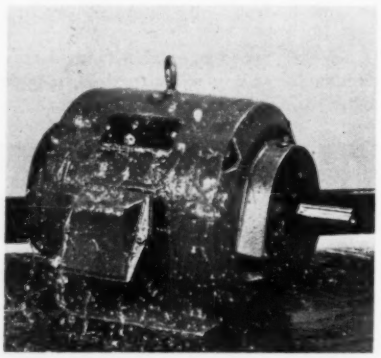


and simplify assembly of centralized graphic control centers and graphic panel boards. Blank symbols are maintained in stock and finished parts are readily available merely by selecting appropriate key dimensions. Both metal and plastic are utilized, and the method of attachment is positive and not discernible. No limitation is made on the finish, and sixteen colors are available as standards. For intricate metal flowlines, a specially designed shaping tool can be provided. *Devco Engineering, Inc.*, P.O. Box 387, Caldwell, N.J.

SAPPHIRE is utilized in the ball poppet of a relief valve designed to allow pressure to escape from a tank in a space vehicle. The sapphire, manufactured by the Linde Company, is also being applied to hot gas or acid valves. Reportedly, the sapphire ball was chosen because of its polished surface and abil-

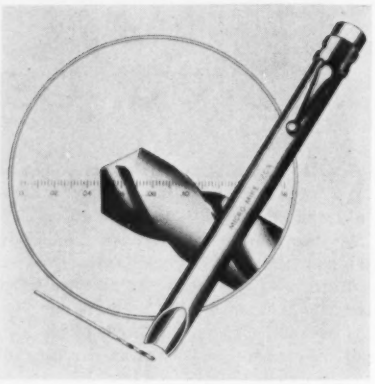
ity to withstand continual hammering against a hard metal seat. Sapphire's extreme hardness prevents scratching, erosion and general disfigurement, thereby insuring minimum leakage. Other advantages include its chemical inertness, high temperature strength and dimensional accuracy. It is currently used as windows and domes in infrared optical systems, windows for high power microwave tubes and for such applications as spacers and supports in vacuum tubes. The material is available in the shape of domes and windows to 4½ inches in diameter, and in special configurations. *Linde Company*, Division of Union Carbide Corporation, Crystal Products Department, 300 Madison Avenue, New York 17, N. Y.

EXPOSURE to extremes of moisture and the elements reportedly does not affect a weatherproof alternating current motor designed for use in outdoor applications. The unit, available in all standard speeds in sizes from 1 through 250 hp, exceeds NEMA splash-proof requirements. All of its external parts are of corrosion-proof cast iron, and shaft openings are sealed by a shaft cap and slinger. The insulation system, said to be completely nonhygroscopic, has silicone sleeving, glass-mica slot liners and glass mat top-sticks and mid-sticks. The



heavy Formvar wire coils have been several times immersed in special thermosetting, oil-and-water-resistant varnish, and then sealed with a final coat of special red finishing enamel. The rotor outer diameter and the stator inner diameter are coated with a rust inhibitor. A special nonwashing grease is used in the Metermatic bearings, that are said to meter just the right amounts of grease from the grease reservoirs. The watertight conduit box is of cast iron with a gasketed cover and threaded outlet. Zinc-plated, noncorrosive hex-head bolts are used throughout the unit. A stainless steel nameplate keeps motor data permanently accessible. *Reliance Electric & Engineering Company*, 24701 Euclid Avenue, Cleveland 17, Ohio.

MICRO-MIKE is a 20-power pocket microscope that has a superimposed scale to permit easy, accurate inspection and measurement of tiny parts. A 4-lens optical system, contained in a lightweight metal casing, provides a flat, undistorted

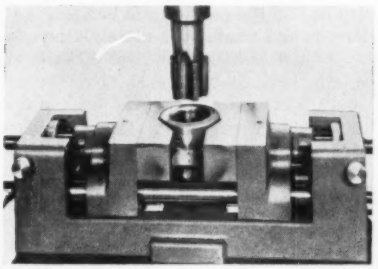


field. The scale, with 0.002-inch graduations, is internal and cannot be scratched or smeared. No adjustments are made and no skill is required in using the instrument. It can be utilized to check fine lines, screens, meshes, fabrics and other surfaces where micrometers cannot be applied. Engineers, toolmakers, assemblers and inspectors can use the device for checking cutting edges of fine tools, hardness tests, abrasive grits and like. The microscope is also available without the scale. *Du-Maurier Company*, Elmira, N. Y.

AQUA-JET is a float-operated air line moisture separator that removes water and other contaminants from compressed air lines. The unit operates on pressures from 10 to 250 psig with either continuous or intermittent flow, causing only small pressure drop and no flutter. It is said the float merely triggers the moisture discharge, rather than actuating the port, and thereby creates a positive action. A built-in impregnated felt cartridge protects parts against rust

and grit. Because the air itself blows out the contaminants, particles reportedly cannot settle on the soft seat when the drain closes. The separator is available with a metal or transparent bowl for lines of ¼- to 8-inch diameters. *Wilkerson Corporation*, 1645 West Girard Avenue, Englewood, Colo.

DESIGNED for holding parts varying in size or shape when the work requires the location of a center or other predetermined point, an air-hydraulic vise, Model 77, finds the point automatically. Two opposing jaws are actuated directly by cylinders on both ends of the unit and their movement is synchronized within a tolerance of 0.001 inch by a gear and rack in the base. Because no pressure is transmitted through the centering mechanism, it is said that the jaw travel is uniform; and because the jaws are mounted on two hardened and ground parallel bars, perfect jaw alignment is possible. The vise features 7-inch-wide jaws that are infinitely adjustable to a maximum 7¾-inch opening, each with a travel range



of 11/16 inch, or a total travel of 1⅜ inch. An air-hydraulic intensifier increases the air pressure into a greater hydraulic pressure, developing a holding power on the work piece of 4000 pounds at 100 psig. *Heinrich Tools, Inc.*, Racine, Wis.

WHIRL-FLO Filterator, Model No. 5704, reportedly provides positive protection for compressed-air-operated equipment against oil, rust, dust and other contaminating particles as small as 5 microns. Containing a Micro Pak textile filter cartridge, the device is especially successful in protecting such equipment as air checking gauges and instrument panels, and for such applications as paint spraying, air finishing processes, oxygen masks, laboratories and wherever pure compressed air is necessary. It is designed to operate on pressures as great as 250 psig with efficient air filtration of flows up to 175 cfm, with minimum pressure drop. A louvered baffleplate causes the air to whirl as it enters, thus centrifugally forcing the foreign particles to the outer walls where they drain into a large sump

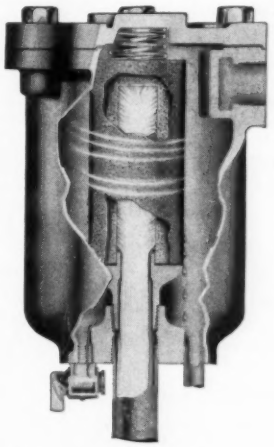
chamber at the bottom without touching the replaceable filter cartridge. The accumulated moisture and sludge may be drained from the sump manually by a standard petcock, or automatically (inset) when the pressure drops to 10 psig or less. The relatively dry, clean air then moves through the Micro-Pak cartridge where micronic particles are trapped. The unit is available in pipe sizes of ¾- and 1-inch NPT, and has an over-all length of 11½ inches and a diameter of 4½ inches. *Wilkerson Corporation*, 1645 West Girard Avenue, Englewood, Colo.

INSTRUMENT manufacturers and users of pneumatic instrument tools will find noteworthy a hydrocarbon vapor adsorption device that provides clean dry air and gas. The unit, called Vape-Sorber, is available in fourteen standard sizes—eleven for normal pressure applications and three for high pressures. Two stages of operation are used for Vape-Sorber, that reportedly, heretofore, has been a specially designed and custom-built unit. In the first stage, water, water-oil emulsion, free oil and dirt are removed from air or gas lines; in the second, oil vapor and free oil mist are taken out as the air or gas is passed through an adsorbent. The device is said to be useful for steel plants, metal fabricators, industrial gas manufacturers, hospitals, pharmaceutical manufacturers and the like. *Selas Corporation of America*, Dresher, Pa.

DUST BOOTS are now being made of a plastic film that is electronically sealed. The bellows may be installed on existing air or hydraulic cylinders without increasing length or space re-

ADAMS PORO-STONE AIR FILTER

designed to remove oil, water and foreign matter from compressed air lines with minimum pressure drop.



The R. P. Adams Poro-Stone air filter is engineered to efficiently remove entrained oil, water and pipe scale from compressed air lines. Liquid droplets and solids being carried by the gas stream are first removed by centrifugal action in an annular chamber. Secondary filtration is achieved by passing the air or gas stream through a Poro-stone unit. An automatic trap can be provided to discharge the residue from the cyclone chamber.

At rated capacity the filters operate at a maximum pressure drop of only ½ lb., thus insuring delivery of line pressure to the point of consumption.

The units require virtually no service or maintenance — thereby insuring continued trouble-free, low cost performance.

ADAMS Poro-Stone air filters are available from stock in sizes to suit your needs. For further information, write today for Bulletin 117, R. P. Adams Co., Inc., 209 East Park Drive, Buffalo 17, New York.

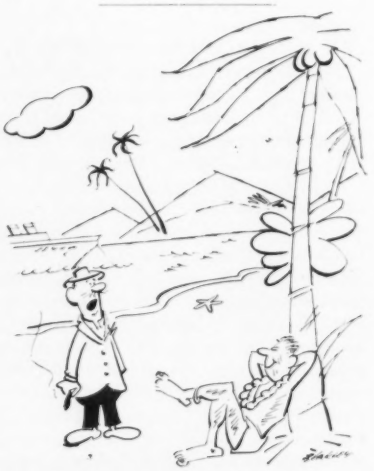
quirements. With a film thickness of only 0.012 inch, which is typical, Gagne reports that it is practical to provide

thirteen convolutions in a space of less than ¾ inch, including the end connections as seen in the illustration (left). This particular boot expands freely as much as 6 inches. Since the units have been applied, other advantages have shown themselves; namely, oil leakage is trapped and readily evident; end connections ordinarily used are designed to permit breathing; and, the dust boot may be fully sealed, if a hose connection is provided to a suitably located vent or expansion chamber. *A. F. Gagne Associates*, 50 Wall Street, Binghamton, N. Y.

MAINTENANCE coating called XL-8 may be applied by dipping, spraying or

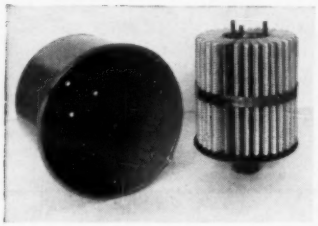
brushing not only to air-dried or baked surfaces, but to uncoated ones as well. The material is said to form a tough elastic cover that is resistant to abrasion, cuts and wear. No heating is required to dry it, and the coating will bond to both ferrous and nonferrous metal. One coat is 4 to 6 mils thick; two, 12-15 mils thick; three, 22-26 mils thick; and four, 34-40 mils thick. It is useful in general maintenance on ducts, tanks, spillage areas, funnels and such handling equipment as hooks, conveyor bars and baskets. XL-8 is supplied in quart, gallon and 55-gallon sizes, as well as in the small manual squeeze-on applicator illustrated above. *The G. S. Plastics Company*, 15583 Brookpark Road, Cleveland, Ohio.

GAS-VALVE lubricant, Molykote Type 1102, was developed and tested to meet the exacting requirements of



"What do you people do for something to worry about?"

NEW DRY TYPE AIR FILTERS
for engines, compressors, blowers and other industrial applications



• Designed for specific applications, the new Air-Maze Dry Type filter is particularly suitable where 1.) oil free air is required, 2.) an extremely high degree of filtration is required, 3.) the air velocity varies from one period to another and, 4.) the dirt concentration is relatively low, except when vibration is present to help dirt removal.

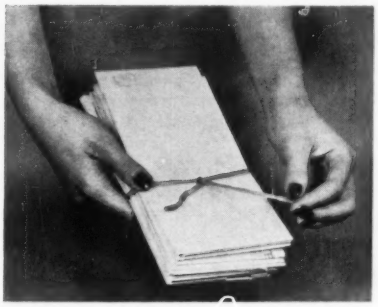
The Air-Maze Dry Filter is one of the most efficient mechanical type filters available. Laboratory tests indicate better than 98% efficiency with particles of 2 micron mean diameter and practically 100% efficiency with particles of 5 microns or larger.

The Air-Maze Dry Filter type DA employs a special highgrade felt filtering media arranged in deep pleats to provide extended area, and armored on both sides by heavy galvanized cloth. Heavy gauge perforated tubing inside the media and a metal strap on the outside form a rigid unit of great strength and are corrosion protected. Made in sizes from 20 cfm to 6650 cfm. Catalog DA-1056 available. Write **AIR-MAZE CORPORATION**, Cleveland 28, Ohio. Department CA-11

AIR-MAZE
The Filter Engineers
AIR FILTERS • SILENCERS • SPARK ARRESTERS • LIQUID FILTERS
OIL SEPARATORS • GREASE FILTERS

gas associations. It is a high-temperature, nonmelting-point grease, fortified with highly purified molybdenum disulphide powder. The grease is recommended for use as a lubricant for plug cocks of metal, plastic or glass on equipment where reliable lubrication in the presence of gases or liquids is required. It reportedly eliminates the gumming formations that usually cause valves to stick. Molykote Type 1102 is resistant to propane, butane, natural gas, manufactured gas, ethyl alcohol, methyl alcohol, dilute potassium hydroxide, dilute sodium hydroxide, dilute nitric acid, concentrated hydrochloric acid as well as boiling water and steam. It is attacked by aliphatic, aromatic and chlorinated hydrocarbons such as gasoline, diesel oil, petroleum, benzene, toluol, xylol, trichloroethylene, esters and aliphatic fatty acids. *The Alpha-Molykote Corporation*, 65 Harvard Avenue, Stamford, Conn.

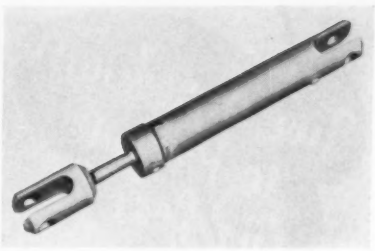
BINDING bundles of documents, drawings, cancelled checks and the like, is expedited with a simple pull fastener that consists of a narrow pink cloth tape and a tiny metal slide. A quick



pull on one end of the tape tightens the binder and a tug on the other end loosens it. Securing the fasteners is said to be many times faster than ordinary tapes. Available in fourteen standard sizes ranging in length from 6 to 54 inches, the tapes can be slipped on as quickly as rubber bands, but do not dry out or break, and will not fray. *Schlegel Manufacturing Company*, 1555 Jefferson Road, Rochester, N.Y.

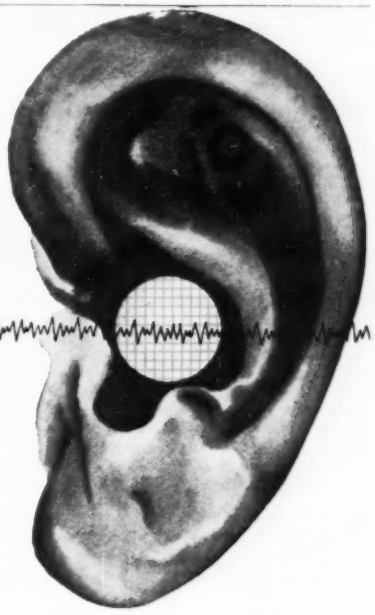
GLASS frosting is another of the applications for the aerosol spray can. The fine mist of Crown Glass Frosting is said to be useful for insuring privacy of security areas, hiding unsightly locations from outside view and for any use where the advantages of ground glass are desired. The spray eliminates liquid "running," it is said, and speeds drying time while applying an even coating of spray. The color is a near-white that blends with all wall or building colors. No color distortion is present. Sun glare is reduced, though the frosting allows light to pass through without changing anything but its intensity. *Crown Industrial Products Company*, 1004 Amsterdam Street, Woodstock, Ill.

AIR and oil cylinders for industrial, mobile and farm applications are offered in eight bore sizes and ten different mounts. Sizes include 1½, 2, 2½, 3, 3½, 4, 5 and 6 inches. Types of mounts are clevis, eye, tube, front flange, rear flange, rabbit, pilot, centerline, side lug and foot mount. Cylinders can be furnished with either O-ring seals for pressures up to 2000 psig or cups and Twin

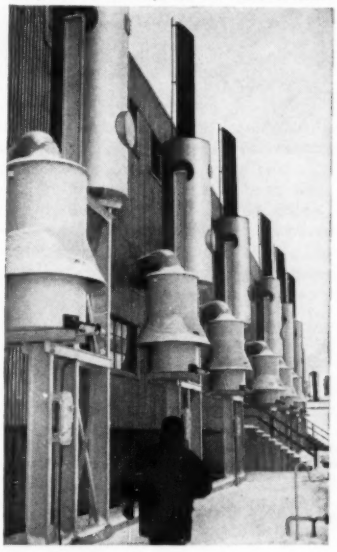


Pak packings for pressures up to 3000 psig. According to the manufacturer, strokes are available in lengths up to 10 feet. *HemcO Manufacturing, Inc.*, Argonia, Kan.

HEAR THE DIFFERENCE A MAXIM MAKES



Compressor station is quieted with Maxim Silencers.



The difference is apparent not only in superior noise suppression, but in the services Maxim provides. *Quick* consultation on your silencer projects — there's a Maxim man near you. *Quick* delivery — many sizes and types from stock. *Experienced* field engineers to help you complete silencer installations quickly, economically and efficiently. Files up-to-date? Make sure. Write for "Guide to Maxim Silencers."

THE MAXIM SILENCER COMPANY

Subsidiary of Emhart Manufacturing Company

61 HOMESTEAD AVENUE, HARTFORD, CONNECTICUT

"AIR KING"

Quick-Acting

HOSE COUPLINGS

For All Hose Connections

These plain rugged couplings are your surest safeguard against loss of air at the hose connections. Universal locking heads, on sizes up to 1", snap together to form a secure lock that is leakproof under pressure; in fact, pressure must be released before coupling can be disconnected. Ideal for rough outdoor work as well as indoor shop and plant service. Malleable iron, cadmium plated, and bronze. Hose Ends, Male and Female I.P.T. Ends. Size range, ¼" to 1". Also available in 4-lug type, not universal, in 1¼" to 2" sizes.

"BOSS"

Self-Honing

AIR VALVES

For the Entire System

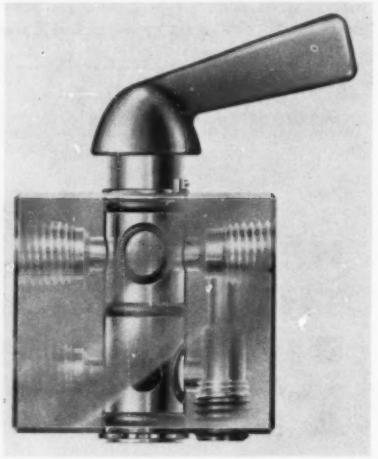
The most efficient and economical valves for all valve stations on the system—automatically, permanently leakproof—no packing to wear out and replace—straight-line, full-flow opening through body and plug. Self-adjusting bronze plug automatically hones itself against harder steel or malleable iron valve body, maintaining a perfect leakproof seat. Proper spring tension assures constant sealing adjustment. Strong, durable construction, with handle attached to plug *within* the valve body. Male or female thread both ends, in sizes ¾" to 1½".

Stocked by Manufacturers and Distributors of Industrial Rubber Products

DIXON
Valve & Coupling Co.

GENERAL OFFICES & FACTORY—PHILADELPHIA 22, PA.
BRANCHES—CHICAGO · BIRMINGHAM · LOS ANGELES · HOUSTON
DIXON VALVE & COUPLING CO., LTD., TORONTO. Associate Companies: Buck Iron Company, Inc., Quarryville, Pa. · Precision Drawn Steel Company, Camden, N.J.

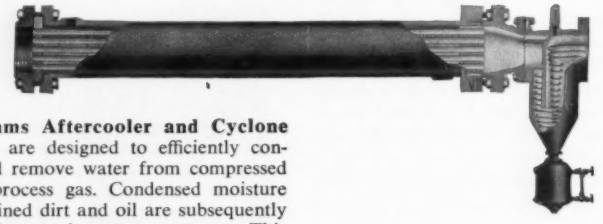
LEAKPROOF shutoff and minimum pressure drop are features of a 3-way plug valve, one of Series 9300. Typical applications for the valve include test benches, pilot and process plants, pneumatic and hydraulic equipment and plant air circuits. The valve is designed for both gas and liquid circuits and has three ports arranged to provide one inlet, one outlet and an exhaust, either piped or atmosphere. When the device is functioning as a selector valve it can be used as having one inlet and two outlets, or two inlets and one outlet. Use of O-rings on the face of a cylindrical plug, and on the diameter of the plug, is said to produce effortless operation and maintenance-free service. The valve's operating temperature range is minus 40° to 250° F, and its operating pressure range, minus 14.7 to 150 psig. *Circle Seal Products Company*, 2181 East Foothill Boulevard, Pasadena, Calif.



"Now, who's the notorious clock watcher you've been complaining about?"

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
209 East Park Drive, Buffalo 17, New York



The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm where it is necessary to cool within 2°F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

Industrial Books And Literature

CARBON and graphite are discussed in a volume that resulted from a symposium on the two materials sponsored by the Society of Chemical Industry of London, England. The conference, held in London in September 1957, consisted of 68 technical papers presented by scientists from England, the Continent (including Russia), and the United States. The papers deal with the physical properties, manufacture and industrial applications of industrial carbon and graphite. It is said that the accumulation of knowledge provides a source of English and European information not otherwise available. Of particular interest are the descriptions of many of the manufacturing methods of the scientists' companies. Specifically, the publication's papers are subdivided into these sessions: Introduction and Physical Properties; The Manufacture of Carbon and Graphite; The Crystal Structure of Carbon and Graphite; Surface Chemical Properties and Reactivity; Electrical Behavior and Applications; Graphite in the Nuclear Power Industry; and Mechanical, Chemical and Metallurgical Applications. *Industrial Carbon and Graphite* contains 630 pages and is illustrated. Cost, $25.75. *The Macmillan Company*, 60 Fifth Avenue, New York 11, N. Y.

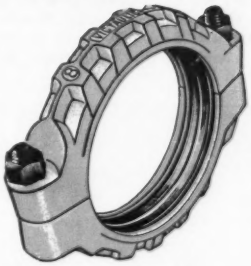
PLANT maintenance and its importance in U. S. manufacturing during the past decade are stressed in a recently published book. The volume reports the proceedings of a plant maintenance and engineering conference held in Chicago in January 1958. Included are texts of 35 papers; some 450 questions and an-

"Some workers can't take a little free advice."

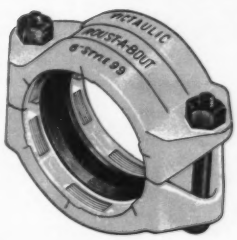
VICTAULIC®

METHOD OF PIPING

VICTAULIC HAS EVERYTHING...



VICTAULIC COUPLINGS
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".



ROUST-A-BOUT COUPLINGS
For plain or beveled end pipe *Style 99*. Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".

VICTAULIC SNAP-JOINTS
The new, boltless, speed coupling, *Style 78*. Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB

VICTAULIC FULL-FLOW FITTINGS
Elbows, Tees, Reducers, Laterals, *a complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".

VIC-GROOVER TOOLS
Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

PLUS FITTINGS AND GROOVING TOOLS

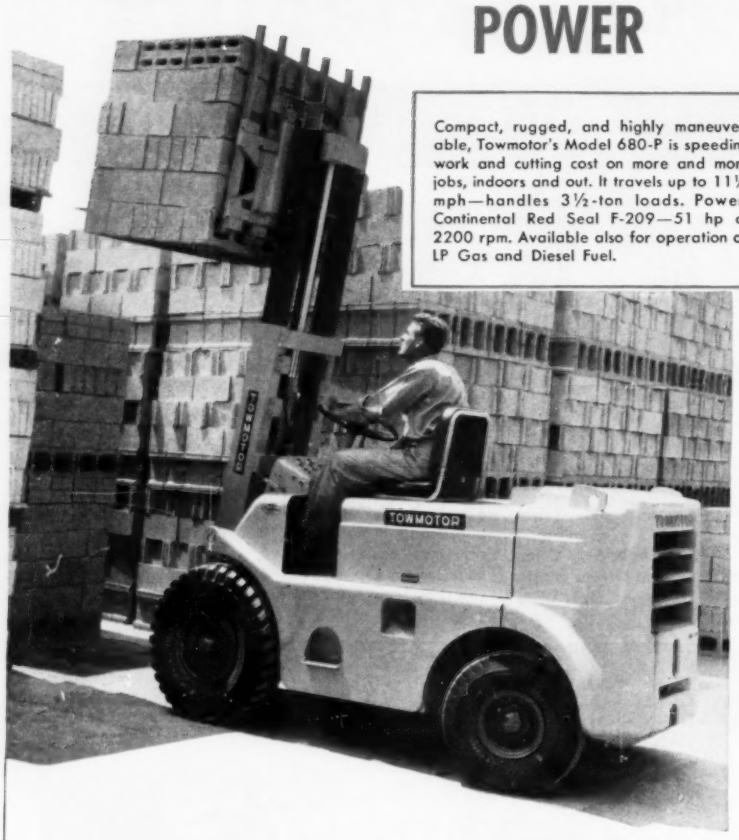
"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast.
Write for NEW Victaulic Catalog-Manual No. B-11

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

Another Winning Combination

TOWMOTOR® and **CONTINENTAL POWER**



Compact, rugged, and highly maneuverable, Towmotor's Model 680-P is speeding work and cutting cost on more and more jobs, indoors and out. It travels up to 11½ mph—handles 3½-ton loads. Power: Continental Red Seal F-209—51 hp at 2200 rpm. Available also for operation on LP Gas and Diesel Fuel.

The pace-setting Towmotors are a good example of what can be accomplished when industrial leaders of the caliber of Towmotor and Continental pool their efforts. Fine result of teamwork between two outstanding pioneers, they combine efficiency, driver comfort, and ease of operation, with a degree of indoor-outdoor versatility that is finding them more and more jobs in the expanding construction field. Their dependable performance, over long periods with an absolute minimum of upkeep, proves that it pays to be choosy about the power that's the heart of the machine—to buy a make that features the in-built extra value of Continental power.

●

ANY EQUIPMENT IS BETTER WITH CONTINENTAL RED SEAL POWER

CONTINENTAL MOTORS · Powerful as the Nation · AMERICA'S STANDARD®

Continental Motors Corporation

MUSKEGON • MICHIGAN

6 EAST 45TH ST., NEW YORK 17, NEW YORK • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 1252 OAKLEIGH DR., EAST POINT (ATLANTA) GA.

swers and an equal number of questions answered in the summary of nine round-table discussions; 42 charts; and tables and illustrations. The introduction points out that the average company investment in plant and equipment for each maintenance worker now totals $63,662. Whereas most of the papers and discussions have general application to all industry, some fields are given special attention, a few being metalworking, petroleum processing and the rubber and chemical industries. Problems of both large and small plants are discussed. The clothbound book, entitled *Techniques of Plant Maintenance & Engineering - 1958*, contains 211 pages. Cost, $10. *Clapp & Poliak, Inc.*, 341 Madison Avenue, New York 17, N. Y.

SULPHUR DIOXIDE is the subject of a 15-page booklet available from Ansul Chemical. Pointing out that it is essential to many widely different industries, the publication discusses this chemical at length, giving the answers to questions most often asked by manufacturers and research chemists. Included in the subject matter are the physical and chemical properties, specifications and specification test methods, suggested uses, toxicity, and shipping procedures. *Ansul Chemical Company*, Chemical Products Department, Marinette, Wis.

SINGLE-PHASE motors of ⅓ to 1 hp for belt-driven fans and blowers are discussed in a brochure released by A.O. Smith. Types and ratings, voltages, operational characteristics, mountings and dimensions of the complete model line are reported in detail. In addition, "exploded" photographic illustrations show design and construction details of each component used in the units. *A. O. Smith Corp.*, Tipp City, Ohio.

"I could have slept another 6 minutes!"

SOMETHING NEW UNDER THE GROUND

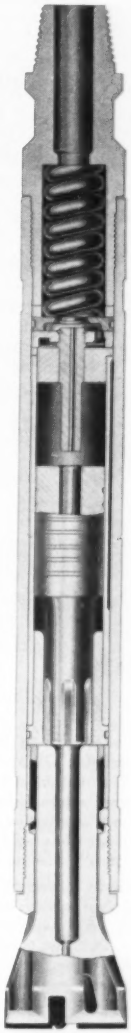
Revolutionary I-R
"DOWNHOLE" DRILL

service-proved on millions of feet of hole,
now available in FOUR SIZES,
with constant, thru-the-bit hole cleaning!

The I-R DOWNHOLE drill is a rugged, heavy-duty, sub-surface percussion drill that delivers full striking power *right at the bit*. Hundreds of units, in operation all over the world, have drilled millions of feet of hole with outstanding records of performance and economy.

Designed for use with Ingersoll-Rand Drillmaster and Quarrymaster drilling rigs, the DOWNHOLE drill is also available to present users of other types of rotary drilling equipment. Conversion from roller cone bits to DOWNHOLE drilling is simply a matter of screwing the drill to the rod or adapter and adding an air-line lubricator.

Here are some of the features that put the DOWNHOLE drill in a class by itself.



PATENTED HOLE CLEANING. All operating air is exhausted through the bit and additional *high-pressure air* blows continuously through the bit for maximum hole cleaning, even while drill is not running.

RENEWABLE WEAR SLEEVE. The entire unit is encased in a renewable wear sleeve that can be replaced at low cost when the outside diameter is worn down. (Patent Pending)

THREADLESS CARSET BIT DESIGN. The service-proved result of years of experimentation and field operation, it has no threads to strip or work loose and no energy loss through a separate connection.

SEALED UNIT. There are no ports in the outside of the drill which could admit abrasive material into the working parts.

CHECK VALVE. An optional check valve can be mounted behind the drill to permit operation under great heads of water—keeps mud and cuttings out of the machine even when the drill is stopped.

SPECIFICATIONS	DHD-275	DHD-325A	DHD-400	DHD-500
BIT SIZES	4¾" & 5"	6" & 6½"	7" & 7½"	9"
ROD SIZES (O.D.)	4"	4" & 5"	5½"	7"
LENGTH (BIT EXTENDED)	52¾"	52½"	63¼"	68½"
OUTSIDE DIAMETER	4¼"	5⅛"	6"	7¼"
WEIGHT (INCLUDING BIT)	158 lb.	236 lb.	362 lb.	586½ lb.

For further details, send for a copy of Bulletin 4203.

Ingersoll-Rand

5-864

11 Broadway, New York 4, N. Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

COST: 2 cents to 4 cents for 8 hours for each 1000 cfm.

JOB: Eliminate carbon build-up in valves, rings in air compressors. Prevent overheating, fires. Increase compressor efficiency. Eliminate or shorten down-time. Cut labor, maintenance 50%-90%.

HOW: Using HYDRODYNE-AC, fed into air intake by drip feed lubricator.

NOW USED: HYDRODYNE-AC, used by auto, chemical and other manufacturers, and public utilites.

GUARANTEED: If HYDRODYNE-AC does not perform as claimed, full refund made.

ORDER NOW:

HYDRODYNE-AC PRICES

$9.95 per gal. in one gal. cans.
9.00 per gal. in five gal. cans.
8.00 per gal. in 55 gal. drums.

F. O. B. Clark, New Jersey

More information available upon request.

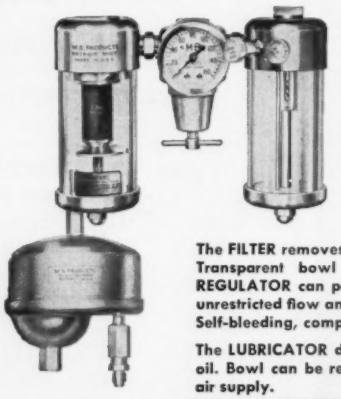
AQUADYNE CORPORATION

10 TERMINAL AVENUE • CLARK, NEW JERSEY

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M-B PRODUCTS
46 VICTOR AVE., Div. 14
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TOOL-OM-ETER
The Pulsation Compensated
AIR METER

4 Ranges Covering From
4 to 450 CFM

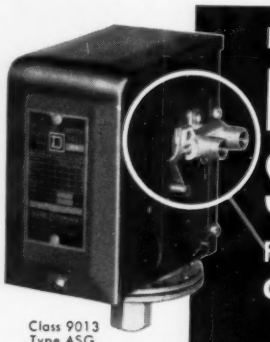
- SIMPLE AND PRACTICAL OPERATION
- RELIABLE AND DURABLE
- PORTABLE FOR FIELD TESTING
- ACCURACY BETTER THAN 1%

New Jersey Air Meters are accepted everywhere as the most practical, reliable and accurate method of air measurement. With the aid of these meters, you can intelligently select the most suitable equipment for your service, maintain this equipment in effective operating condition, make repairs and adjustments when needed, locate leaks and losses, and scrap the "air eaters" when they become obsolete or worn beyond repair.

These meters show directly on a scale, in cubic feet of free air per minute, the flow of air in a pipe or hose. They measure the air consumption of any pneumatic tool, rock drill, air motor, sand blast, air lift, or other application of compressed air. They permit the control of air flow to any operation or process at the rate that gives the most effective production and highest air economy.

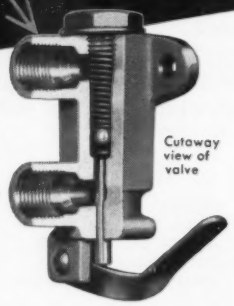
FOR THE COMPLETE STORY, WRITE FOR BULLETIN A-8

NEW JERSEY METER CO., INC.
350 Leland Avenue • Plainfield, New Jersey



HEAVY DUTY PRESSURE SWITCH FOR AIR COMPRESSORS

Class 9013
Type ASG
Form X



Cutaway view of valve

COMPLETE RANGE IN 1 CONTROL UNIT

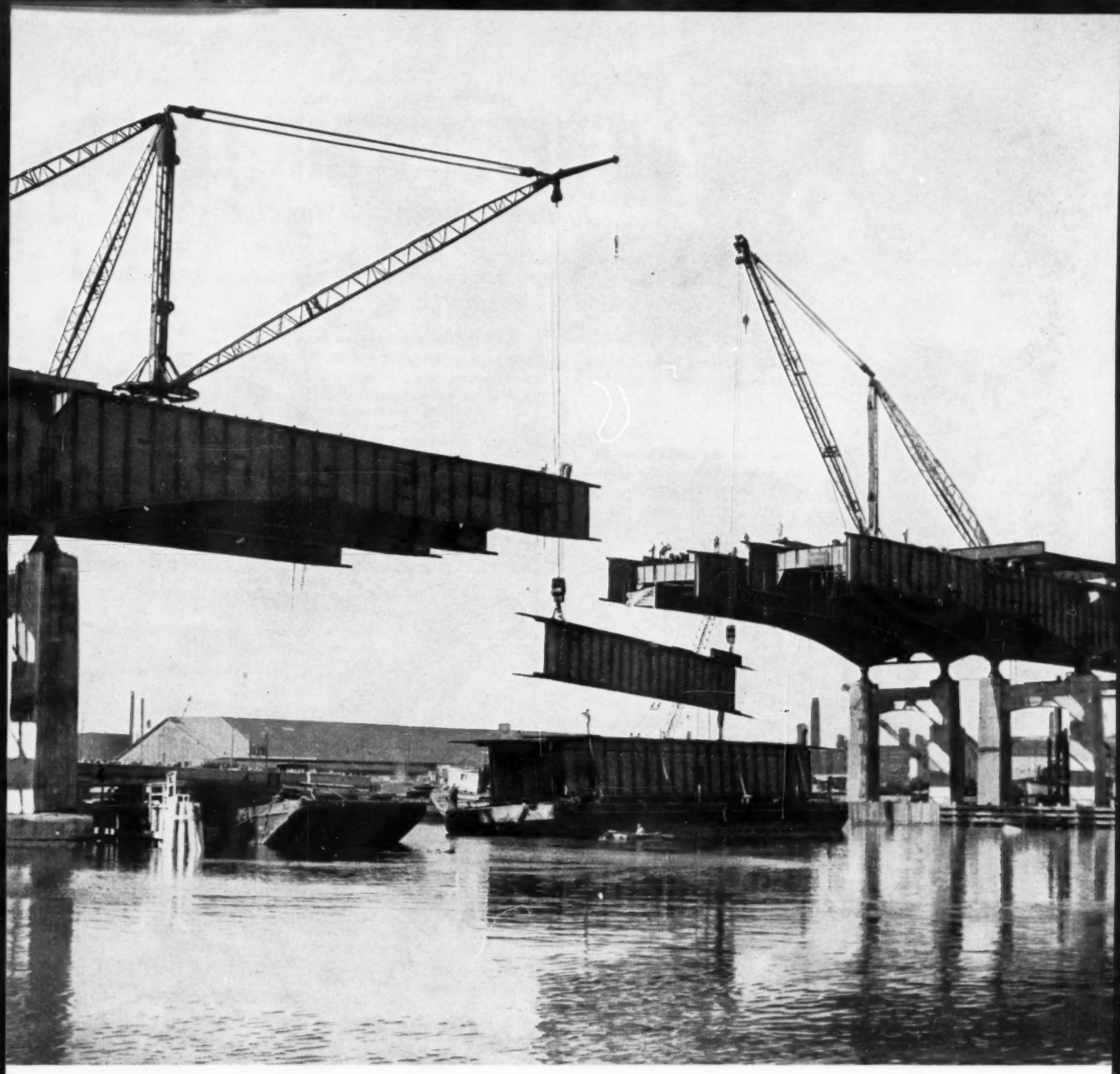
Either 20 to 180 or 25 to 250 PSI.
No spring changes required.

MORE AIR CAPACITY
with improved 2-way ball and "O" ring type valve.

Write for Bulletin 9013A. Address Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE

SQUARE D COMPANY



Where Traffic Now Hums Over New Haven's Waterfront. Scenes like this were so familiar during the building of the Connecticut Turnpike. The one shown here is New Haven's waterfront section as the Quinnipiac River Bridge was nearing completion. The bridge's center span, measuring 387 ft, is the longest continuous plate-girder span in the country.

That big girder being hoisted above the channel weighs 89 tons. The span has four such units, side by side, joined at both ends to 140-ft cantilevered arms. Bethlehem wire rope—tough, flexible, and strong—was given the task of lifting these girders and other heavy loads. The ropes on the two big travelers were Purple Strand grade, Bethlehem's improved plow, which is always recommended for jobs of this nature.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

CONSTRUCTION • EXCAVATING • MINING • QUARRYING • PETROLEUM • LOGGING • MANUFACTURING

NOW 200 NEW I-R AIR TOOLS

to help you cut fastener costs and increase output!

assembly machines

The ultimate in fastener and assembly efficiency —whether it's to automate a single nut running operation or a complete assembly line.

Screw driver with automatic feed for one or more screws—readily adjustable for various screw spacings.

screw drivers

More than 94 new sizes and models featuring instant push button reverse, renewable trigger bushing, wider operating range, more power and more accurate control.

Self-sealing rubber faced throttle valve simplifies maintenance.

ratchet wrenches

Designed for close quarter nut running, these wrenches combine the powerful "Multi-Vane" air motor with a simple, efficient ratcheting mechanism.

Like all I-R ratchet wrenches, Model 001JW can be used for removing nuts, by simply turning tool over.

angle wrenches (torque control)

Adoption of these new Torque Control Angle Wrenches expands I-R's line, making it the most complete on the market. Unique feature is automatic torque control valve which shuts off air to the motor when nut is run to pre-determined torque.

Built in torque control is a feature of this I-R size 38PT. Torque ratings range from 5 to 100 ft. lbs.

impactools (torque control)

Revolutionary new Torsion Bar Torque Control provides control never before possible. Basic principle is I-R's time-tested, exclusive ball and cam impact mechanism.

Speed and flexibility of famous I-R Impactool is combined with maximum torque control in this Model 5040T.

Easiest way for you to cut production costs and increase man-hour output is with new, more efficient air tools. Tools shown here are representative of the more than 200 new, more productive tools added to the I-R line in the past two years. Power increases ranging up to 75% help to cut costs on fastening operations.

For detailed information about the complete I-R line of cost-cutting Air Tools—call or write your nearby I-R office.

8-880

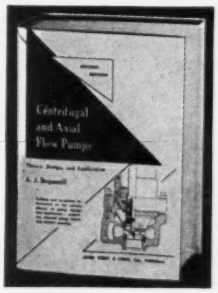
Ingersoll-Rand

Tools plus AIRengineering increase output per man

Complete information on pump design and application . . .

NEW SECOND EDITION

CENTRIFUGAL AND AXIAL FLOW PUMPS



By A. J. Stepanoff
Development Engineer
Ingersoll-Rand Company

Keeps pace with progress . . .

Revised and expanded to reflect the significant advances in recent years in the field of centrifugal pumps, this book provides a modern treatment of the whole field. Includes a method of attack based on: a single pattern of flow; identical theoretical reasoning; and similar design procedure for centrifugal, mixed flow, and axial flow pumps.

Features of the 2nd edition . . .

- New material on centrifugal-jet pump systems
- Important design elements and performance characteristics incorporated in a single chart covering all important design elements
- Chapter on water-hammer problems
- A Concise account of progress in water storage pumps
- New charts relating to impeller design for any discharge angle
- . . . and many others

1957. 462 pages. $12.00

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COMPRESSED AIR MAGAZINE
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LOW COST
Preventive Maintenance

For Pipe, Pipe Joints, Fittings, Couplings, Tanks, etc.

Use TAPECOAT®

...the Quality Coal Tar Coating in Handy Tape Form

To combat corrosion on underground pipe lines, you need the best possible protection at lowest possible cost. Since 1941, TAPECOAT has proved its superiority in resisting moisture, acids, alkalis, chemical fumes, electrolysis, soil stress, salt water and other severe corrosive and abrasive conditions. TAPECOAT is self-bonding, easy to apply spirally with the use of a torch. Requires no skilled help. Cuts maintenance and replacement costs. Comes in rolls of 2″, 3″, 4″, 6″, 18″ and 24″ widths.

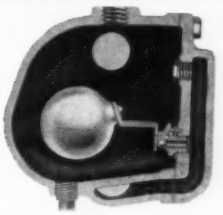
Write for brochure and prices

The **TAPECOAT** *Company* 1571 Lyons Street Evanston, Illinois

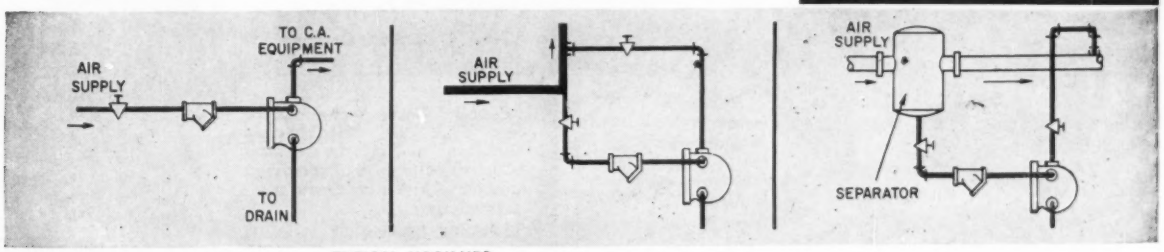
Sales and Service Offices in Principal Cities

INSTALL NEW SARCO FA DRAIN TRAPS

and get more work from your CA tools



Cross-section of Type FA Drain Trap showing float design that keeps condensate level above trap, providing seal against air leakage.



TYPICAL HOOK-UPS

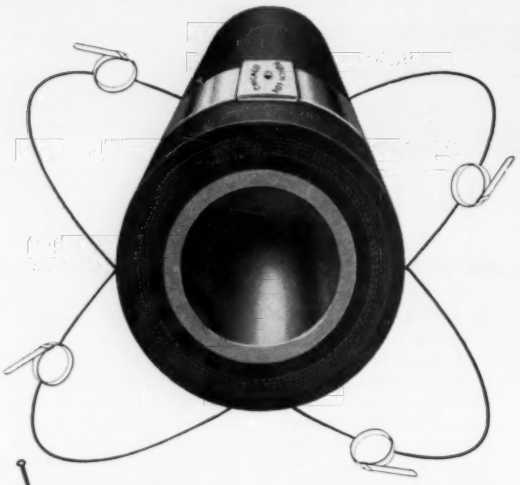
The typical hookups illustrated here will help you get more useful work from your compressed air tools. Sarco Automatic Drain Traps keep condensate level in trap body above the valve. That maintains a positive seal against air leakage and gives you a steady supply of dry air. Dry air saves maintenance, too, and prevents damage to tools from impaired lubrication and waterhammer. It avoids slowed-down production resulting from freezing in tool exhaust.

Write for "Literature Kit C A" and get bulletin full of ideas to help increase effectiveness of your present air compressor capacity. 5892-F

SARCO COMPANY, INC. 635 Madison Ave., New York 22, N. Y.

DRAIN TRAPS • COOLING CONTROLS • SAFETY CONTROLS • IMMERSION THERMOSTATS • STEAM TRAPS • STRAINERS • HEATING SPECIALTIES

IN ORBIT for a LIFETIME!



PUNCH-LOK Hose Clamps

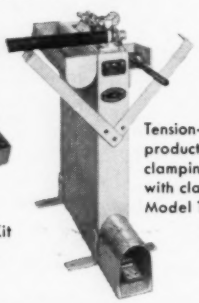
MR. LOK SAYS:
When a Punch-Lok clamp goes into orbit around a hose connection it's there to stay.

DOC PUNCH SAYS:
Tell the hose user it's a life-saver prescription for outer-space too.

NO SNAG! NO LEAKS!

NEW! from PUNCH-LOK

New K-45 Clamp-Master Kit now in all-steel carrying case finished in red baked-on enamel.



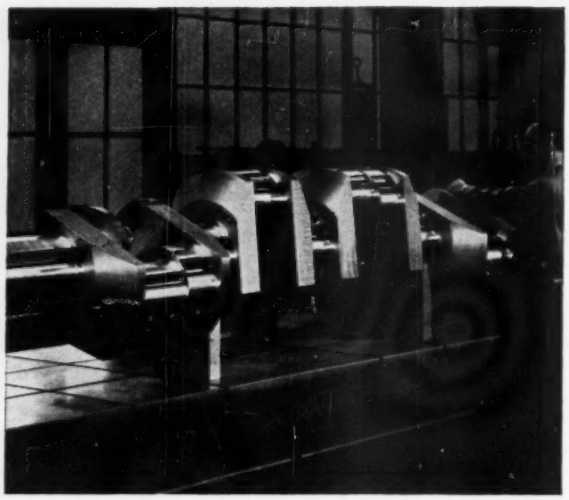
Tension-Air production hose clamping machine with clamp remover Model TA-1.

See your nearby Punch-Lok Distributor 8382

"The Sign of a GOOD Hose Clamp"

PUNCH-LOK Company

Dept. H, 321 N. Justine Street, Chicago 7, Illinois



WHO FORGES THE TOUGH CRANKSHAFTS ?

.... and machines them, too

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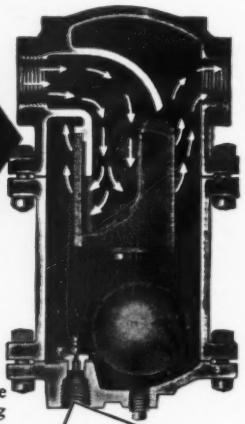
NO MOISTURE OR DIRT GETS BY HERE



Johnson Self-Draining Compressed Air Separator.....

Like all Johnson Separators the new Type "SA" Self-Draining Separator combines the two most effective principles of removing moisture and dirt from compressed air:

1. Controlled expansion of air in separator precipitates most of the moisture.

2. A "thousand baffles" of coarse mesh repeatedly changes flow of direction to capture remaining foreign matter.

Johnson Separation Devices include Separators for Compressed Air or Steam. After coolers, oil absorbers.

Self-Draining—a simple but complete trap mechanism built right in, automatically drains separator whenever necessary.

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The Johnson Corporation

WOOD STREET THREE RIVERS, MICH.

"Used many makes of turbines... PREFERS COPPUS"

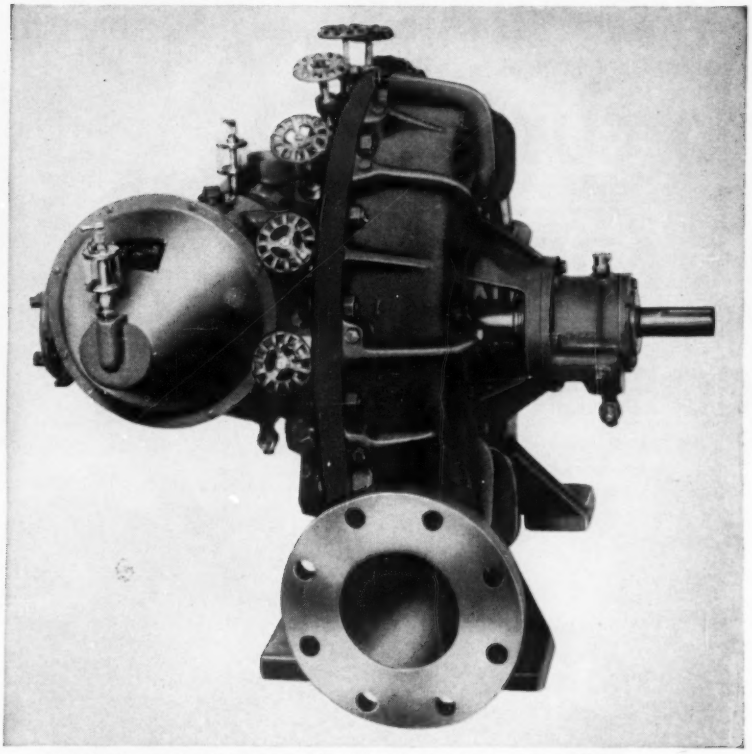
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

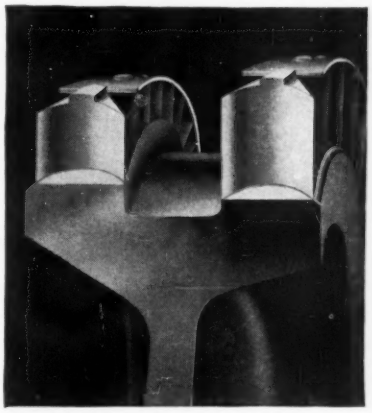
Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

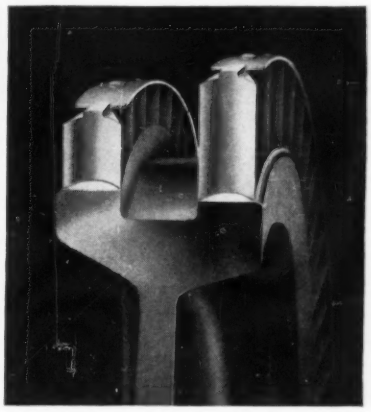
COPPUS ENGINEERING CORPORATION
21 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER



This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.



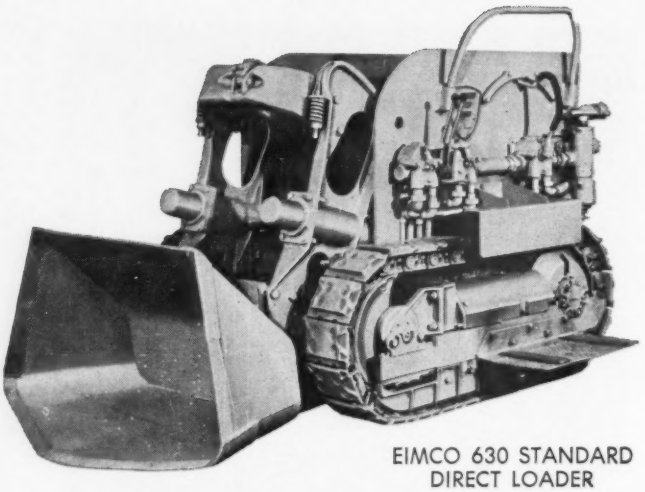
This wide bucket "L" type wheel is a new development for use where low water rate is essential



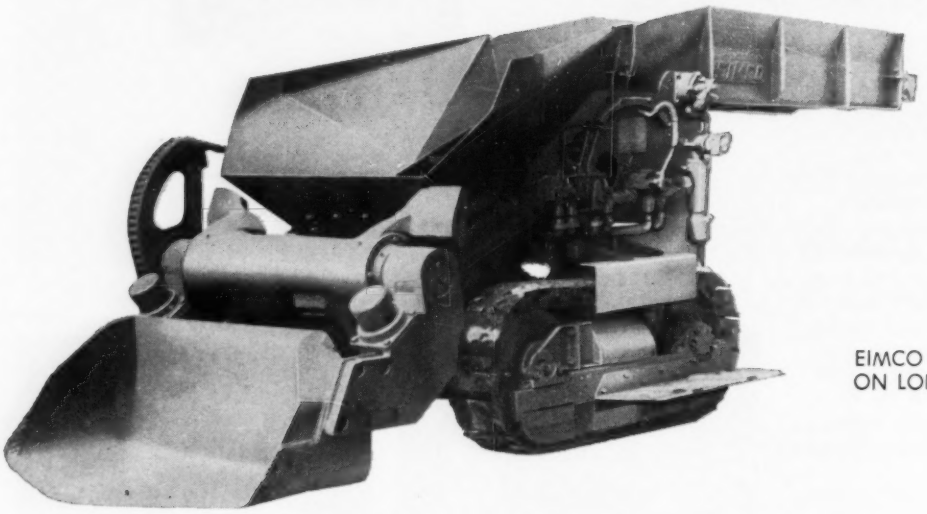
This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

COPPUS "BLUE RIBBON" TURBINES

TWO WAYS TO CUT LOADING COSTS



EIMCO 630 STANDARD
DIRECT LOADER



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ON LONG CARS AND TRUCKS

We ask that when you consider underground loading equipment, you keep in mind the qualifications which only Eimco has — to give you, for any condition, the best machine for the job.

Eimco is not only the pioneer in the design and building of wheel and trackless mine loading machines, but it is also the oldest and the largest manufacturer in this field.

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The combination of Eimco's experienced engineering; its big, integrated world-wide manufacturing facilities; and its famous reputation for heavy, rugged construction make real and certain the claim — "You can't beat an Eimco."

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B-354

The SNAP Makes the Difference

IN THIS AIR TRAP

NO COSTLY AIR LEAKS WITH THE

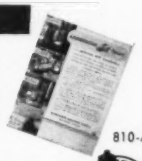
ARMSTRONG SNAP-ACTION TRAP

The spring-powered valve snaps wide open for fast drainage, snaps tightly closed before all water leaves trap—always a perfect water seal. No dribbling, no air loss. Snap-closing prevents fine grit from holding the valve away from the seat.

Trouble-free construction: the flat-strip spring of special Swedish steel lasts for years . . . valve and seat are hardened chrome steel. Cast semi-steel body for pressures to 250 lbs., forged steel for pressures to 1000 lbs.

SEND FOR HELPFUL BULLETIN

Bulletin 2024 tells how to select the right air trap for any job. Gives complete information on all Armstrong air traps for every service. To get your copy, just call your local Armstrong Representative, or write:

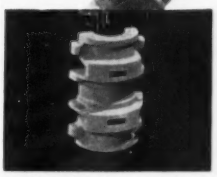


810-AT

8856 Maple St., Three Rivers, Michigan

ARMSTRONG MACHINE WORKS

BEARIUM METAL superiority proved in over 25 years of "on-the-job" service in scores of varied applications.



Special castings made to customer's specifications.

Wherever there is a bearing application involving high speeds, poor lubrication, heat-generating loads, elevated temperatures, dusty and gritty surroundings—or where a liquid other than oil is used as a lubricant—there you will find the ideal application for BEARIUM METAL. For it is under adverse operating conditions such as these that BEARIUM METAL out-performs all other types of bearing materials . . . by prolonging bearing life, preventing shaft seizure and scoring. In short, it does a more efficient job longer at lower operating cost.

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Clamps of all diameters formed from continuous roll of stainless steel band without waste . . . for a few cents and in a few seconds.

THE BAND-IT **CLAMP WAREHOUSE**

Holds 900 BAND-IT industrial pressure clamps in approximately 1 cubic foot of space.

Carry BAND-IT tool, band and buckles (all that is needed to form Band-It clamps) in this portable Clamp Warehouse, just like a tool kit. Makes 900 stainless steel clamps of all diameters—for any type clamping job, any shape of object. Especially useful for emergencies such as leaking pipe or hose. 1001 other uses.

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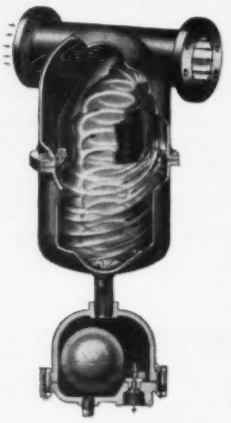
BAND-IT CLAMPS GO ROUND THE WORLD

Ad No. 26 7-58

New Design Assures Maximum Entrainment Removal With Low Cost "T" Separator

Redesigned annular passage increases centrifugal force. Separated moisture, oil and solids travel outer wall to lower collecting chamber. Large diameter, high level outlet reduces velocity, eliminates entrainment problems. Screwed ends ½" thru 3". 125 lbs. flanged ends 2½" thru 8". Low cost in-line installation.

Combined with No. 90AC automatic drain trap to prevent loss of steam, air or gas provides most efficient and economical separator-drain combination available.



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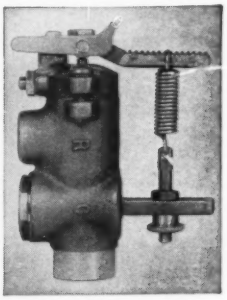
24 HOUR SERVICE

Factory Rebuilt

UNLOADER VALVES

any age
any make
any condition



One day is all it takes to change old, worn-out unloader valves into factory rebuilts with new valve guarantee. Conrader exchanges all makes. Cost 1/3 less than new valves.

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R. CONRADER CO. INC.
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At the North Jersey Quarry Co., Summit, N.J., a Bucyrus-Erie 4½-yd. 110-B loads out blasted rock for hauling to crusher.

PROFITABLE EXPERIENCE

brings customers back for more

When final operating figures are tallied, it's the Bucyrus-Erie that produces more at less cost per ton . . . makes *repeat buyers* of customer after customer.

There are good reasons why Bucyrus-Eries give this kind of performance. Bucyrus-Erie-improved Ward Leonard controls have revolutionized shovel operation by giving operators immediate extra torque to meet every load, faster acceleration and deceleration on every move. Their consistency has been job-proved. They require little maintenance.

Bucyrus-Erie's exclusive two-section boom with tubular dipper handle provides unusual strength with minimum weight. Twin dual hoist concentrates power at the point of greatest resistance to steady the dipper and pull it through the toughest banks.

From the treads up, Bucyrus-Erie electric shovels are heavy-duty units designed to give you greatest output at lowest cost. Write today for complete information on the 4½-yd. 110-B, 6-yd. 150-B or the 8-yd. 190-B. Bucyrus-Erie Company, South Milwaukee, Wisconsin.

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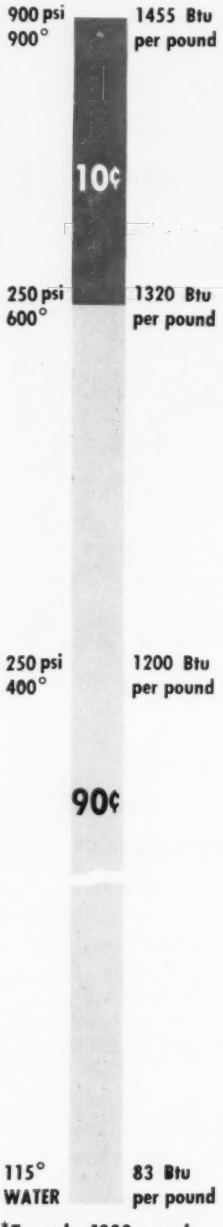
Wherever high-pressure steam is available the

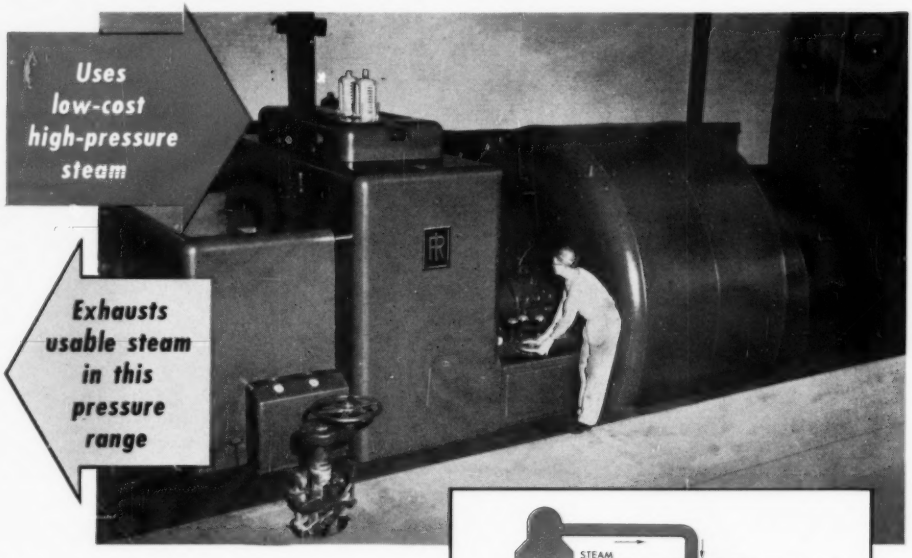
NEW I-R TOPPING TURBINE

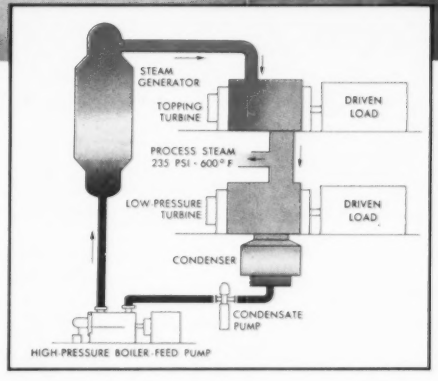
can cut driving costs as much as 75%

STEAM COSTS*



*To make 1000 pounds of steam (assume $1.00)





10,000 hp I-R Topping Turbine driving an I-R 90,000 cfm blast furnace air blower in a large steel plant. Turbine operates at 850 psig, 850 F and exhausts steam at 235 psig for driving other Turbo-Blowers. Diagram at right shows steam flow in a typical Topping Turbine and condensing turbine arrangement.

Designed to use only the low-cost portion of high-pressure boiler output, the new Ingersoll-Rand Topping Turbine can save as much as 75% in the cost of driving compressors, blowers, pumps or other rotating equipment.

As shown by the graph at the left, steam can be raised from 250 psi, 600 F to 900 psi, 900 F at an increase of only 10% in total steam costs. The I-R Topping Turbine is designed to operate on this low cost portion of high-pressure steam—discharging up to 300-psi steam for operating other equipment.

The I-R Topping Turbine provides other economies, too—eliminates condensing system, saves space, saves cooling water, saves installation time and expense.

Incorporating the most advanced "big turbine" design features, the I-R Topping Turbine provides long range economy in a wide range of operating conditions. It is available for pressures to 1250 psig, temperatures to 1000 F, steam flows to 500,000 lb/hr and speeds to 6000 rpm in the 10,000 to 20,000 hp size. For further information, send for Bulletin 8299.

Ingersoll-Rand

12-885

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